

Longitudinal Analysis of Public Responses to Wildland Fuel Management: Measures to evaluate change and predict citizen behaviors in agency decision processes

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I. ABSTRACT

Wildland fire policy in the U.S. has increasingly emphasized proactive efforts to reduce wildfire risks while restoring ecosystem health and protecting communities through fuel reduction practices (Stewart et al. 2007). Citizen support is a basic requirement to project implementation and long-term success. This project examined the factors that contribute to public acceptance of fuel reduction programs and the federal agencies that implement them. Through a unique study design (among fire management research to date), results enable identification of changes in citizen responses over time and comparisons between different geographic locations.

This study was designed to improve our understanding of the factors that influence citizen acceptance of agency fuels reduction treatments over time. This project addresses a key gap in the literature by comparing survey responses from the same sites over time. Specific objectives include 1) complete a longitudinal analysis of citizen responses in seven locations across the study period (2002-2008), 2) compare findings across locations to examine commonalities and key differences, 3) conduct an analysis of intervening activities as potential influences on public acceptance, 4) identify factors that influence public responses and contribute to support of agency programs, and 5) examine more recent concerns expressed by managers since the initial 2002 studies. Findings have important practical implications for developing effective fuels treatment programs.

II. BACKGROUND AND PURPOSE

Several recent federal initiatives (e.g., the National Fire Plan, Ten Year Comprehensive Strategy, Healthy Forests Restoration Act) have focused on fire and fuel management. Two main themes run through these initiatives. First, they emphasize the use of fuel treatments, such as prescribed fire and mechanized thinning, to reduce the risk of fire. Throughout much of the previous century federal fire policy was directed at excluding fire from the landscape. In recent years, resource managers and scientists have increasingly recognized the complex and often beneficial role that fire plays in forest and rangeland ecosystems. In many locations, fire exclusion has resulted in ecological changes, such as shifting species composition, increasing vegetative density, and declining ecological health (e.g., Langston 1995, Agee 1997). These changes have greatly increased the risk of large wildfires. Thus, in addition to suppression activities, contemporary fire management aims to proactively manage forest structure with two main objectives, reduction of fire risk and restoration of forest health (Mutch et al. 1993, Agee 1997).

Second, these policies recognize the wildland fire problem is extensive and solutions will require an unprecedented degree of collaboration with a broad array of stakeholders. Indeed, these policies encourage, and in some cases require, local partnerships to identify and accomplish fuel management objectives. Thus, resource professionals require an understanding of citizen awareness and acceptance of the fire risk and the tools available to help mitigate those risks.

A growing body of research evaluates public opinion about the use of prescribed fire, thinning treatments, and their associated impacts. Several important findings emerge from this work.

Decades of research demonstrate that citizens with higher fire-related knowledge are more supportive of fuel management activities such as prescribed fire and thinning programs (e.g., Stankey 1976, Carpenter et al. 1986, Manfredo et al. 1990); these findings have been verified in recent work conducted by the investigative team (Shindler and Toman 2003, Brunson and Shindler 2004). Moreover, overall public understanding and acceptance of fuel treatments has steadily increased over the past decades. Early studies found that citizens generally overestimated the negative impacts of fire; not surprisingly, a majority preferred complete fire suppression (Stankey 1976). But over the last several years, an increasing number of citizens recognize the role of fire on the landscape (Loomis et al. 2001, Shindler and Brunson 2003).

In addition to citizen knowledge, findings across several locations indicates that acceptance of fuel treatments hinges on 1) public confidence in agencies and trust in local managers to effectively implement treatments (as the treatments themselves carry their own risks and uncertainties), 2) the degree to which citizens have an opportunity to participate in fire planning, 3) citizen beliefs about the outcomes likely to result from treatments, and 4) public confidence that forest managers provide credible information regarding their fire and fuel management activities (e.g., Winter et al. 2002, Shindler and Toman 2003, Shindler et al. 2009).

While much has been learned to date to help inform fire and fuel management, most of this prior research has consisted of studies conducted at a single point in time. Currently there is a lack of longitudinal data from which to measure how people react to changing conditions and test how specific variables contribute to their response to agency fire and fuels programs. This type of information is essential for resource professionals to evaluate the success of management actions and predict support for different treatments, the effect of communication and outreach programs, and which factors lead to trustworthy relations in communities. The study reported here meets a critical gap in the literature by completing a longitudinal analysis of citizen responses across a six-year study period in seven locations (Arizona, Colorado, Oregon, Utah, Michigan, Minnesota, and Wisconsin). Findings, thus, enable comparisons across both time—to identify changes in citizen responses and analyze influencing factors—and geographic locations—to recognize commonalities as well as key differences in citizen responses.

This project was developed in response to a 2006 Announcement for Proposals by the Joint Fire Science Program to build on and extend results of completed JFSP research by re-measurement of public responses to fuel treatments and agency planning processes. Findings have substantial practical implications and can help improve the processes used to develop fuel management plans. Specific research objectives include:

- Complete a longitudinal analysis of citizen responses in seven locations across the study period (2002-2008).
- Compare findings across locations to examine commonalities and key differences.
- Conduct an analysis of intervening activities (e.g., fire events, fuel reduction practices, agency outreach and communication strategies, citizen participation in fuels mitigation, etc.) that have occurred across the study period at each site as potential influences on public acceptance.
- Identify factors that influence public responses and contribute to support of agency programs.
- Examine more recent concerns expressed by managers since the initial 2002 studies.

III. STUDY DESCRIPTION AND LOCATIONS

This project replicated measures from two previous studies: 1) a JFSP study conducted by Bruce Shindler, Mark Brunson (Utah State University), and Eric Toman in fire-prone communities in four western states (Arizona, Colorado, Oregon, and Utah) and 2) a similar National Fire Plan study for the Northern Research Station by Shindler, Toman, and Sarah McCaffrey in communities adjacent to National Forests in the Lake States (Michigan, Minnesota, and Wisconsin). See the section on *study locations* that follow for a description of these communities. Survey protocols were conducted in the winter and spring of 2002, prior to both the Hayman Fire in Colorado (6/8/02) and the Rodeo-Chediski Fire in Arizona (6/18/02).

The follow-up study in 2008 employed a triangulation of qualitative and quantitative research methods to complete a longitudinal analysis of citizen perceptions of fuel and fire management programs at each study location. The project was implemented in two stages:

- **On-site research:** The project began with a qualitative analysis of the current conditions and management activities (intervening factors) that have occurred since 2002 within each study location. The research team conducted semi-structured interviews with federal fire management personnel and project cooperators in each location. The research team also completed a content analysis of available documents (including agency plans and documentation, outreach materials, and media reports) related to fire and fuel management at each site. These data enable assessment of themes and key influences at each location and contributed to survey design. Qualitative data was analyzed using interpretive coding techniques to reveal key themes from interview responses. This resulted in a rich description of contextual variables at each location. Findings from this stage of research helped identify current issues of concern to fire management personnel that could be addressed in the 2008 survey. Short site descriptions are included in this report. More detailed versions are available from the authors.
- **Longitudinal surveys:** The study used mail-back questionnaires to measure citizen perceptions of fire management, understanding of forest conditions and fuel treatments, and preferences for treatments. Survey design was based on the original study and replicated essential measures from 2002. The level of inquiry in 2008 was expanded to assess the influence of intervening factors on dependent variables including citizen understanding, attitudes, support, and levels of trust. Questions included Likert-type scales and closed-choice question sets. Surveys were implemented following a modified version of the “total design method” (Dillman 1978). Mailings were sent in three waves. First, a complete mail packet (cover letter, questionnaire, and stamped return envelope) was sent to all respondents. Two equally detailed mailings followed to non-respondents to encourage participation.

Quantitative analysis of survey responses included multiple steps. The data was first summarized using descriptive statistics. Next, responses were paired across pre-test and post-test measures and compared using paired t-tests with individual respondents serving as the unit of analysis. This enabled assessment of change in individual responses between 2002 and 2008. Findings were also compared across study locations using chi-square tests. Lastly,

correlation analysis was completed on 2008 responses to examine influences on citizen acceptance of agency treatments.

Samples and response rate

In 2002, a random sample of households in each location was selected for participation. Samples from Colorado and Utah, which contained large metropolitan areas, were stratified by oversampling rural households to ensure sufficient levels of participation from WUI residents while the Lake States sample was drawn from counties adjacent to National Forest land. In 2002, 1159 individuals participated in this project. After accounting for respondents who had moved from the study regions, were deceased or otherwise incapacitated, a combined total of 1000 individuals remained in our sample for 2008. Of these, 546 completed the survey for a 55% overall response rate (see Table 1). Response rates varied from a low of 51% in Utah to a high of 59% in Colorado.

Table 1: Sample size and response rate

	2002 original sample	2008 adjusted sample*	2008 completed surveys	2008 response rate
Total	1159	1000	546	55%
AZ	151	111	60	54%
CO	149	121	71	59%
OR	161	122	71	58%
UT	147	134	68	51%
MI	168	151	81	54%
MN	191	179	99	55%
WI	192	181	96	53%

* accounting for initial respondents who had moved or were deceased

Study locations

The seven locations included in this research are briefly described below.

- **Central Arizona Highlands.** Yavapai County, AZ, including the rapidly growing communities of Prescott and Sedona. Dominant vegetation types are ponderosa pine forest and oak-juniper savanna. At the time of the first study, there had been no significant wildfires in the area for several years. However, significant fire risks had prompted local fire protection authorities and Forest Service personnel to cooperate in creating a citizens’ wildland-urban interface committee to actively promote fuel reduction. This initiative soon became the Prescott Area Wildland Urban Interface Commission, a highly successful group that included members of federal forest agencies (USFS, BLM), local and state government, and a contingent of highly motivated landowners. It is still plays a major role in the community. Meanwhile, treatments were also occurring on federal lands throughout the area, primarily prescribed fire and thinning activities. In 2002 the entire county was

threatened by the Indian Fire, which destroyed 5 homes. Since then there has been a moderate level of fire activity, but no other large fires within the region. Nevertheless, managers report a higher than average fire consciousness among members of the local public. In addition, most fires in Yavapai get substantial media attention due to the proximity of a major media market in Phoenix. The largest fire in Arizona history, the Rodeo-Chediski fire, occurred the summer following the original study (2002); while not directly threatening those in the sample, it likely impacted participants.

- **Colorado Front Range.** Boulder and Larimer counties, including the northern part of the Denver metropolitan area between the cities of Boulder and Fort Collins, a rapidly growing WUI zone in the Rocky Mountain foothills, and tourist communities adjacent to Rocky Mountain National Park. Ponderosa and lodgepole pine stands dominate the forest area. Locally noteworthy wildfires had threatened or destroyed homes in the decade prior to the study; both the National Park Service and the Forest Service proposed a mix of thinning and prescribed fire to reduce fuel hazards. Leading up to the 2002 study, the agencies developed a widely distributed newspaper insert to raise public awareness of the local fire hazard and potential management actions and public involvement activities associated with some highly visible fuel reduction projects. Several months after the 2002 study, the Hayman fire—the largest in state history—occurred in adjacent counties. This event prompted the formation of the Front Range Fuels Treatment Partnership that includes federal, state, and local management agencies. It acts as a forum for sharing information and outreach materials between agencies and with the public. The Front Range Roundtable is an offshoot group and includes a wider range of public and private stakeholders. The Colorado State Forest Service is in a primary role of helping communities develop CWPPs, although this is a fairly recent development. .
- **Central Oregon.** Deschutes and Jefferson counties, including rangeland areas to the north and east and vacation communities on the west, with the fast-growing towns of Bend and Redmond in between. Natural vegetation includes juniper woodland and ponderosa pine forest, with the latter having sustained recent large wildfires that threatened or damaged homes and property. A significant grass roots movement has resulted in rural homeowners' associations, the Forest Service, the Bureau of Land Management, and Confederated Warm Springs Tribes cooperating on fuel reduction activities, emphasizing mechanical removal and prescribed fire. Communication strategies include interpretive exhibits at visitor centers, agency newsletters, demonstration sites, and partnerships with local “friends” groups. There has been substantial local fire activity since the study period, including the 2002 Cache Mountain Fire, which destroyed two homes and caused dozens of evacuations in the resort community of Black Butte Ranch, the 2003 B&B Fire, which consumed over 90,000 acres and caused the evacuation of the community of Camp Sherman, and the 2006 Black Crater Fire which resulted in the evacuation of two subdivisions near the town of Sisters. A substantial number of homeowner groups are also undertaking defensible space initiatives with help (i.e. leadership, resources) from the state department of forestry and two NGO's that promote such programs. The state of Oregon also passed a law requiring homeowners in the WUI to certify their property as fire-safe. A number of cooperatively developed CWPPs have been completed with others still in progress.

- **Utah Great Basin.** Tooele and portions of Salt Lake and Utah counties, including the western suburbs of Salt Lake City and Provo plus portions of the sparsely populated West Desert. Frequent wildfires in nearby grasslands and oak-juniper woodlands have drawn public attention but property damage has been low. Grazing by goats has been used to reduce fuel hazards in oak thickets within a rapidly growing WUI zone, while the Bureau of Land Management uses prescribed fire, mechanical treatments, and restoration planting to reduce fire hazard associated with invasion of non-native annual grasses. Outreach activities have included displays at public events and contacts with local TV and newspaper outlets. In September 2003, a management ignited prescribed fire escaped in nearby Uinta County leading to substantial smoke in communities within the study area. The 2007 Milford Flat Fire, which burned south of the study region, was Utah's largest fire. Although it burned primarily in rangelands away from large population centers, it received substantial media coverage and resulted in closures of Interstate 15, vehicle accidents, and evacuations of small communities in the area. The CWPP process is well underway with the state providing a standardized template for interested jurisdictions. Many of these CWPPs are developed on a contract basis and involve little leadership or participation by residents.
- **Michigan.** The Huron-Manistee, Ottawa, and Hiawatha National Forests make up the vast majority of federal public land ownership in Michigan. Primary management emphases are recreation and timber production on the Hiawatha and Ottawa National Forests, and a split between multiple uses – including threatened and endangered species management, recreation, fire, timber, and oil and gas development – on the Huron-Manistee. The survey sample included communities adjacent to the national forests. Several small fires occur on Michigan national forests each year. Recent large fires include the Hughes Lake Fire on the Huron-Manistee and the Sleeping Lake and Stonington Fires on the Hiawatha. Two previous fires on the Huron-Manistee National Forest still have a strong influence on citizen confidence and support of manager-ignited prescribed burns (Winter et al. 2002). In 1980, a Forest Service prescribed burn escaped and became the Mack Lake fire that eventually burned 24,000 acres and 44 structures. This was followed in 1990, by the Stephen Bridge Road fire which burned 6,000 acres of public and private land and destroyed 76 homes. Although these events occurred over a decade ago, citizen memories of them are still strong.
- **Minnesota.** The Chippewa National Forest is located in north central Minnesota, adjacent to Itasca, Cass, and Beltrami counties, and overlaying almost entirely the Leech Lake Band of Ojibwe reservation and has experienced relatively little recent fire activity. The Superior National Forest in northeastern Minnesota has experienced substantial recent fire activity – the Alpine Fire in 2005, Cavity Fire in 2006, and the 70,000 acre Ham Lake Fire in 2007. In 1999, severe storms caused a 300,000 acre blowdown event in the popular Boundary Waters Canoe Area in the Superior National Forest followed by substantial public education and restoration treatments which received substantial media coverage. Communities adjacent to both forests were included in the study.
- **Wisconsin.** The Chequamegon-Nicolet National Forest is located in northern Wisconsin, bordered to the north by Lake Superior and Michigan's Upper Peninsula. Management emphasis on this forest includes ecological restoration following substantial blowdown in 2007, in addition to a strong timber program. Fire activity in the region has doubled in the

last 5 years, coinciding with a persistent drought. Managers estimate 60 or more fires burn on the forest every year, most of which are small and generally human-caused. In spite of their small size, the majority of fires threaten structures and result in evacuations. All communities adjacent to the Chequamegon-Nicolet National Forest were included.

IV. KEY FINDINGS

Findings illustrate the complexity of citizen attitudes toward fire and fuel management. Overall, responses suggest substantial stability in participant acceptance of treatment use between 2002 and 2008. Those changes that did occur generally reflect growing acceptance of fuel treatments across the study period. Findings also highlight several key differences between locations—in general participants from the western states were more positive about fuel treatments and their experiences with agency managers than those in the Lake States (on some items Minnesota residents were more aligned with the western counterparts). Notable findings include:

Participant Perceptions, Experiences, and Local Actions

- Approximately two-thirds of study participants believe the public forests in their area are healthy. However, responses suggest important localized issues exist. More residents in the Lake States considered their forests to be healthy than at other sites. In contrast, perceptions about unhealthy conditions were most prominent in Colorado with 69% of residents rating them as such.
- In both 2002 and 2008, participants estimated the distance from their home to where a fire might burn. In aggregate, mean distances reflect little change. However, at two study sites shifts occurred over time. Colorado and Oregon residents judged their homes to be 1.3 miles further from risk than in 2002. While additional data would be required to confirm, such a change may suggest these homeowners perceived success in the fuel treatments around their communities.
- Expectations about a wildfire occurring locally in the next 5 years remained consistent from 2002 to 2008. This is particularly true in the western states where more than three out of four expected a fire to occur close to their home in the near future. The highest level of concern was registered in Oregon (87% likelihood of fire); no doubt a result of the high frequency of fires in the area during the study period. Minnesota residents were least likely to expect a fire, with only one-third of residents indicating one was likely in the next 5 years.
- Fire activity over the study period was most prominent in the western states; well over two-thirds of participants at these sites (93% in Utah) acknowledged a wildfire had occurred in their area. However, there were relatively few impacts to residents. Although most experienced some discomfort from smoke, few were evacuated and none experienced any damage to their property.
- In 2008, one in four participants was aware of a locally developed CWPP. Just 10% said they belonged to a homeowner or property group that has organized, or is attempting to

organize, a fire-safe or defensible space program. Residents in Arizona, Colorado, and Oregon were more likely to answer positively to these questions.

Public Acceptance of Fuel Management Practices

- Overall, there is substantial public acceptance for the use of prescribed fire and mechanical vegetation removal to reduce forest fuels across these seven study sites. Positive responses were marked by their consistency across the study period, demonstrating a steady level of support for active forest management. In both 2002 and 2008 at least 80% of study participants agreed these treatments could be used either with full discretion by managers or sparingly in carefully selected areas. The latter is already the common approach among management agencies.
- While there is continued acceptance of the use of prescribed fire in each location, participants were more positive in their support of mechanical vegetation removal; 62% gave managers full discretion to use this method to reduce fuels in the 2008 study. This was a small, but significant, increase in support since 2002. Particularly in fire prone communities such as these, residents may recognize a need for the use of mechanical treatments to modify current forest conditions prior to implementing an extensive prescribed fire program, especially in the WUI.
- In general, residents are becoming more comfortable with the use of prescribed fire; concerns with most potential risks decreased between 2002 and 2008, including damage to private property, loss of wildlife habitat, threats to public water supply, and decreased recreation opportunities. Only one potential concern—economic loss of useable timber—increased from 2002 to 2008.
- Most participants specifically indicated a willingness to accept the potential inconveniences associated with smoke from prescribed fire. In a related question, only 5% of all participants in 2008 felt that because of smoke, prescribed fire is not worth using.
- Despite the high levels of acceptance for fuel treatments, participants were less confident in the ability of agency personnel to effectively implement practices. Even though treatments had been used in all study locations during the study period, there was no significant movement in confidence levels. Overall in 2008, about 30% of respondents expressed limited or no confidence in managers to use either prescribed fire or mechanical removal. Although 70% still voiced some degree of confidence, these figures indicate a substantial portion of stakeholders are skeptical of agency actions.
- A more general question asking if respondents felt that their trust in the local forest agency had changed from 2002 to 2008 as a result of how personnel managed fire and fuel practices provided a slightly more favorable response. For three-quarters of study participants their trust level had not changed. Of the remainder, more indicated an increase (than decrease) in their trust over time. The most common reasons given for increased trust were improved citizen-agency interactions, increased fuel reduction activities, and success in suppressing recent fires.

- In 2008, participants rated the importance of 11 factors in influencing their judgments about forest agency actions and decisions. Overall, six factors were rated as important by two-thirds of participants when making judgments. Three of these are directly related to decision-making processes:
 - When local citizens are included in the planning process
 - When I know the objectives of a proposed management action
 - My trust in the decision-maker
 - The decision maintains forest access for recreation
 - How the decision affects my personal property
 - The decision leads to active management to maintain or restore conditions

Among the 11 factors provided, economic considerations received the lowest ratings.

- Study participants were also able to recognize a number of positive outcomes from fuel treatments. Overall, a majority agreed that both prescribed fire and mechanized treatments would reduce fire risk, restore forests to more natural conditions, save money by reducing the cost of fighting wildfires, and improve conditions for wildlife. Additionally, two-thirds felt that mechanical removal was useful for extracting wood products.
- It is clear that communities have different concerns and opinions about forest practices. For example, study sites in Arizona, Oregon, and Minnesota appear much more comfortable with implementation of treatments and see fewer risks in using them. Economic considerations were greater in Oregon, Utah, and Minnesota. Alternatively, Michigan respondents expressed higher levels of concern, particularly over prescribed fire, and less acceptance of management practices overall. This emphasizes the point that no one approach works in all places. Paying close attention to the interests of local communities, levels of understanding and agreement among citizens, as well as their specific concerns seems a prudent course of action.

Citizen-Agency Interactions and Information Exchange

- Numerous studies show that positive citizen-agency relations are required for successful implementation of fire management programs. In 2008, our study participants rated their experiences with local federal forest management agencies and the effectiveness of different agency outreach methods. It should be noted that about one-third of the participants had no personal knowledge about this topic, and thus could not respond. Still, levels of agreement with all statements provided were low, at best indicating a rather tepid assessment of how agencies are interacting with their stakeholders.
- In aggregate, just under half of respondents agreed with the following statements:
 - The agency is open to public input and uses it to shape management decisions
 - Managers build trust and cooperation with local citizens
 - Managers do a good job of providing information about management activities
 Even fewer believed there are adequate opportunities for citizens to participate in local agency planning processes, while about one-fourth are skeptical of information they see from the agency.

- Ratings of the methods used by agency managers to communicate with local residents followed a similar pattern. As noted above, many participants had no exposure to many information sources, so in this case only individuals who had experience were asked to respond. Findings indicate that more interactive forms of communication—such as visitor centers, conversations with agency personnel, educational workshops, and demonstrations of management practices—were the most useful at the study sites. Several forms of communication that consist of a one-way flow of information were also useful, including brochures, interpretive signs, and internet web pages. In order to appeal to a diverse audience, findings indicate agencies should utilize different forms of information exchange as part of a comprehensive outreach effort.
- Findings further illustrate the need to revise the manner in which public meetings are framed and/or conducted by agencies. Although these meetings are often intended to promote citizen involvement, three out of four participants agreed that public meetings in their current format offer limited or no usefulness.
- On a positive note, despite the many potential influences that exist in forest communities, a majority of participants noted forest agencies were the most influential factor in forming their opinions about practices to reduce the risk of wildfire. Federal forest personnel were rated more highly than the threat of a wildfire occurring nearby as well as the local fire management agencies.
- Clear differences exist among geographic regions regarding the strength of citizen-agency relationships. Residents in Arizona typically gave their local forest agency the highest marks for community interactions, while participants from Michigan generally rated the local agency much lower.

Correlation Analysis—Factors influencing public acceptance of agency programs.

Previous research has identified several factors that influence public acceptance of fire and fuel management (e.g., Winter et al. 2002, Shindler and Toman 2003, Shindler 2006). Many of the variables tested in this study are drawn from this work. In this section we use bivariate correlations to test the strength and direction of association between certain participant characteristics and treatment support levels. For example, we can test whether support is associated with education and if the association is direct (more education leads to increased support) or inverse (more education leads to decreased support). The following bullets discuss some of the areas where we found significant relationships. The Socio-demographic section also describes several regional differences; otherwise discussion represents aggregate responses for all sites.

- **Socio-demographic variables:** Public attitudes about natural resource issues are often associated with socio-demographic characteristics (Steel et al. 1997). The data provided limited evidence of influence on citizen acceptance of agency practices from demographic variables such as age (not significant), gender (not significant), or formal education (significant, though weak, direct influence on acceptance of prescribed fire). The lack of

relationships with socio-demographic variables parallels findings from other wildfire studies (e.g., Shindler and Toman 2003). We did find that respondents who were aware that their community had developed a Community Wildfire Protection Plan were more likely to support prescribed fire use. One variable, environmental/economic orientation had a strong and highly significant influence on citizen acceptance of thinning treatments; those who favor management priority be given to economic considerations were significantly more likely to support mechanized thinning.

Regional differences were apparent throughout. Generally, participants in western states were more accepting of fuel treatments and saw less risk associated with using them than those from the Lake States. However, Minnesota may be the exception as in some cases participants seemed to align with responses from the west. It is apparent that where wildfire is more frequent and/or more treatments have been applied on the ground, then stakeholders begin to understand the need for mitigation and respond with support for management activities. Additionally, in states where multi-party efforts and partnerships have been organized and had time to mature (i.e., Arizona, Colorado, Oregon), communities seem further along in their acceptance and support of agency programs.

- **Perceptions of risk:** We examined the influence of perceptions of wildfire risk in the study areas as well as potential risks associated with treatment implementation. Interestingly, there was no association between perceived likelihood of a local wildfire event occurring in the near future and support for agency treatments. This finding contradicts a common assumption that as people recognize the potential risk that a wildfire might occur, they will in turn support efforts to reduce those risks. This matches findings from other wildfire and natural hazards studies that indicate that the relationship is more complex than simple cause (perceptions of risk) and effect (risk reduction) (e.g., McCaffrey 2006).

Thus, we examined the risk associated with the use of prescribed fire on a series of more specific forest attributes, and correlations emerged. Not surprisingly, these results identified an inverse relationship between participant concerns and acceptance. Specifically, as participants indicated increased concern with a prescribed fire getting out of control or resulting in damage to private property, reduced scenic quality, or increased smoke levels, they were less likely to support the use of prescribed fire.

- **Treatment outcomes:** Citizen acceptance of both prescribed fire and mechanized treatments was significantly associated with perceived outcomes from treatment use. Participants who believed the practices would reduce wildfire risk, restore forests to a more natural condition, save money by reducing the cost of fighting a wildfire, and improve conditions for wildlife were more likely to support their use. Additionally, those who believed prescribed fire would create more smoke in the short-term, but less smoke over time strongly supported its use. On the other hand, those who indicated treatments would result in decreased scenic quality were less supportive. These findings suggest the importance of emphasizing specific expected outcomes and helping people understand the potential benefits of fuel treatments.
- **Citizen-Agency interactions:** Citizen-agency interactions also had a significant influence on acceptance of both treatments. Respondents who believed their local agency was open to

public input and did a good job incorporating public concerns in management decisions were more likely to support both prescribed fire and thinning. In addition, respondents who agreed their local forest agency did a good job at providing information about their management activities were more likely to support the agency's use of prescribed fire. These findings are similar to those found in other studies (e.g., Winter et al. 2002, Shindler and Toman 2003).

- **Trust in Management Agencies:** As has been found elsewhere, citizen trust in agency managers had a strong influence on citizen support for both treatments (e.g., Shindler and Toman 2003, Winter and Cvetkovich 2003). Citizens who trusted their local forest agency to provide good information about their management activities were more likely to support treatment use. Overall, the strongest influence on acceptance of fuel reduction practices was citizen trust in agency managers to effectively implement treatment activities. A case in point is the use of mechanical thinning; those who believed the practice would not lead to more harvesting than necessary strongly supported the treatment.

V. MANAGEMENT IMPLICATIONS

- **Capitalize on existing public awareness and support:** Given the controversy surrounding most federal resource management decisions, agency personnel can feel that there is little public support for or understanding of management actions. However, citizens in each location recognize the need for fuel reduction and are supportive of agency fuel programs. This support remained consistent across the study period. While participants were still willing to give managers greater discretion to use mechanical methods, concerns with the use of prescribed fire decreased over time. Moreover, while smoke impacts are often cited as an impediment to prescribed fire treatments, responses here suggest participants are willing to accept some inconveniences from smoke. Collectively, these findings provide positive news for agency efforts to reduce fuel levels. They also suggest that this existing base of supportive stakeholders could be a central asset in building future management programs.

This does not mean participants were willing to give managers carte blanche to do as they see fit. Trouble spots still exist (and are discussed in the points below). The job of developing public acceptance of fire management programs is a continuing process rather than an end product. While responses here are strong, continued support will depend upon the ability of fire management personnel to develop programs that are relevant and responsive to public needs.

- **Tailor outreach programs to the local level:** Results here also emphasize the importance of tailoring programs to address local needs. There were several notable differences in responses between locations. These highlight the importance of developing a strong understanding of relevant concerns, information needs, preferred communication methods, and opportunities to engage residents at the local level. Ultimately, residents in these forest communities are directly affected by agency fire and fuel management efforts. While residents enjoy the benefits of such treatments, they also bear the costs of any negative impacts ranging from smoke or damage to private property from the use of prescribed fire to altered stand composition and resulting changes to forest values. To be successful, managers will need to illustrate the rationale for specific activities and the expected outcomes at the

local level. Management approaches seen as implementing a one-size-fits-all approach and the same old generic outreach activities are unlikely to resonate with local residents. The essential elements in information delivery and the credibility of the information provider are often overlooked, but how and where people get information matters greatly. Facts do not speak for themselves; they must be interpreted and appreciated by individuals.

- **Focus on relationships with local citizens:** Responses here highlight frustration with a lack of opportunities for citizen involvement in agency decision-making processes. Specifically, results from the correlation analysis emphasize the importance of citizen-agency interactions to acceptance of fuels practices. The level of such concern varied between locations, but participants in each study site called for greater participation. No doubt, some opportunities for citizen involvement do exist in each location as part of the agency planning process. However, as responses here and elsewhere illustrate, citizens want an expanded role beyond what is typically available through standard scoping meetings. Citizen participation is most useful when people have an understanding of the consequences of the choices. Gaining public acceptance often relies on the ability of management personnel to frame options in clear and meaningful terms, often through personal contact.

Considerable opportunity likely exists in each of these locations to expand the role of citizen groups in the fuel reduction battle. Local watershed councils, friends and sportsman groups, and homeowner associations are greatly concerned about these conditions and usually have a real stake in the outcomes. Paying attention to local communication networks and working within the existing structure of these organizations can serve the common goals of public and private stakeholders. For example, management personnel have dedicated substantial efforts to develop such approaches within the Arizona and Oregon study regions and they received higher ratings from study participants.

- **Emphasize trust-building:** The common thread that runs through these findings is the importance of trustworthy relations among stakeholders. Indeed, trust in agency managers to effectively implement treatments was the strongest influence on citizen acceptance of both prescribed fire and mechanized thinning. Thus, the most troublesome findings in this study are the poor ratings given to citizen-agency interactions and the low levels of confidence in agency managers to effectively implement fuel management programs. Resource managers should look at trust-building as the central goal of agency programs and not simply expect it to result as a by-product of developing science-based management plans.

Ultimately, citizens in each of these study locations are looking to managers to provide leadership on fire and fuel management issues. By engaging citizens to identify current priorities and examine potential responses and likely outcomes, including any risks or uncertainties, managers may feel they are giving up some of their decision authority. While there is no doubt that citizens expect to play a role in the decision-process, in the end the power to make the decision rests with the agencies. That does not change when greater opportunities are offered to engage citizens in the decision-making process. What can change is the support such plans receive and the responsibility local residents will share to accomplish the fuel management job.

VI. RELATIONSHIP TO OTHER RECENT FINDINGS AND ONGOING WORK

Members of the research team are involved in a number of ongoing efforts that build from this research:

- **An Analysis of Homeowner Adoption, Maintenance, and Support for Fuel Treatment Practices.** A primary concern among fire management professionals is the ability to ensure continuing maintenance of fire mitigation treatments on private lands in the WUI as well as garner continuing support for agency policies. This project is a longitudinal study of homeowner behaviors for mitigating fire risk. We are evaluating citizen attitudes and behaviors over time to determine factors that influence a long-term commitment among community members.
- **Social Science at the Wildland Urban Interface: Creating Fire-Safe Communities.** This project will summarize and prioritize current knowledge related to the social issues of fire management and develop effective tech transfer methods to communicate findings that can be understood and implemented by local agencies and citizen groups. The first phase of this research brought prominent social scientists together for a workshop to examine the body of social science research and to suggest which questions merit further investigation. This event also served as a conduit for bringing scientists together for future collaborative efforts.
- **Social Acceptability of Alternative Management Practices: Restoring Sage-Steppe Ecosystems in the Great Basin.** This project is the social component of a long-term study focusing on the health and restoration of the Great Basin Ecosystem. It involves scientists from all appropriate disciplines and from multiple federal agencies and universities. The intent is to use an interdisciplinary approach to examine important factors for restoration, fire management, and fuels reduction.
- **Building Community Capacity through Citizen-Agency Collaboration.** Research is underway to examine agency efforts at improving public interactions—and consequently, community stability—through long-term collaboration, stewardship contracting, and partnerships with local stakeholders.
- **Concept and Application of Mindfulness in Fire and Fuel Management.** This research will explore the current research on mindfulness in fire management and its relationships to high reliability organizations. It intends to identify common factors across applications and to build a framework for testing these concepts in a variety of fire management settings.
- **Characterizing and Modeling Social Network Effects.** This project will identify the social networks (e.g., neighbors, property owner associations, conservation or environmental groups, forest land owner groups, local governments, and federal managers) that influence the way individuals view risks associated with wildfire and the manner in which individuals respond to agency programs. This information will be incorporated into the Envision modeling system with ecological and topographic data to examine the factors involved in decision-making processes.

- **Developing a Comprehensive Guide for Fuel Management Decisions.** Considerable research exists to inform fuel management decisions. This project will draw on scientific expertise of the research team, fire ecologists, and wildfire biologists, along with direct interactions with practitioners to develop a comprehensive guide and decision-aiding tool to help balance the multiple objectives (e.g., hazard reduction, ecological restoration, habitat improvement, commodity production, and influences on recreation opportunities and amenity values) for the implementation of fuels treatments in mixed white and red pine forests in the Great Lakes region.

VII. FUTURE WORK NEEDED

Additional research is needed in the following topic areas:

Fire preparedness and mitigation

- Complete a synthesis and meta-analysis of existing findings at both the individual homeowner and community level to clarify principles that influence acceptance and behaviors (e.g., adoption/maintenance of defensible space), important contextual influences between locations, trends in responses over time, and current gaps in our understanding.
- How do public perceptions of risk (short-term and long-term) differ from the risks that management agencies contend with? How do these change over time? How does risk perception vary across cultural and social groups?

Fire management and public response

- Smoke is one of the most contentious issues with the use of prescribed fire, but limited research has explored acceptance of smoke beyond basic opinions. Remaining questions include: How does the public weigh tradeoffs between smoke from natural (uncontrolled impacts) and management-ignited events (ignitions under favorable conditions)? What levels of impact from management activities are acceptable? What public communication approaches can enable managers to work through the complexities of smoke from various sources (i.e., prescribed burns, wildfire, manager-controlled wildfire) to more effectively achieve fire management objectives?
- Evaluate pros and cons of evacuation and alternative models to evacuation. Examine the “prepare to leave or stand and defend” as well as other models and their considerations for effective implementation in the U.S.
- To better place research on trust in context there is a need to synthesize what has been learned to date specifically related to fire management. Such work would develop a better understanding of complexity and multiple components of trustworthy citizen-agency relations specific to fire. For example, how do the basic tenants of trust (e.g., honesty, fairness, openness, competence) found in other agency-public interactions apply to different stages of fire management (pre, during, and post-fire)?

Temporal connections

- Limited research indicates that management activities to engage local communities prior to a fire event influence the ability to manage a fire and contribute to post-fire recovery. Additional research is needed across the full spectrum of pre, during, and post-fire to understand how activities in the pre-fire stage (including communication efforts, public engagement, etc.) contribute to improved management of a fire event and subsequent recovery. Of particular interest is an examination of information needs and communication preferences across the different stages and how are they influenced by factors facing managers (e.g., time, funding, immediacy, community resources capabilities, credibility, relations with local citizens).

VIII. DELIVERABLES CROSSWALK

Deliverable	Description	Status
Project website	Deliverables available at www.firescience.gov (JFSP website)	Updated as products are completed
Qualitative summary	Key findings from initial qualitative research assessing contextual factors and change within study areas from 2002-08	Completed
Study protocol	Questionnaire for expanded replication and evaluation	Completed
Project Reports	<ol style="list-style-type: none"> 1) Survey results (quantitative findings across all study locations) 2) Future Research Needs in Social Science for Wildland Fire Management 	Completed
Summaries of findings with management implications	<p>Summaries of key findings in graphical format with management implications.</p> <ol style="list-style-type: none"> 1) Profile of Study Participants 2) Citizen preferences for fuel management practices 3) Agency communication methods and citizen-agency interactions 	Ongoing completion, final summaries in progress
Progress reports	Description of progress towards objectives, timeline of project, findings to date	Completed annually
Field Guide	Provide agency managers with a set of guiding principles and a step-wise process to organize, monitor and evaluate interactions with community groups and citizens	In progress
Interactive workshops/courses	<ol style="list-style-type: none"> 1) Midwest Jack Pine Symposium. Odanah, WI 2) Society of American Foresters workshop. Bend, OR 3) Victoria (Australia) Bushfire Workshop 4) Student/faculty seminars at Oregon State University 5) Spotlight on Science Workshop. Cooperative effort by BLM, USGS, USFS, and USFWS. Portland, OR 6) NAFRI course, Tucson, AZ 7) Washington Institute, Bothell, WA 	Ongoing
Research articles	Peer reviewed journal articles or GTR chapters	Completed 7 to date; other articles forthcoming (see list below)
Conference presentations	Presentations of results at scientific conferences	Completed 7 to date, more forthcoming
Final report	Summary of research design, findings, and influence of factors on citizen responses	Completed

Project Reports and Summaries

Shindler, B., E. Toman, and S. McCaffrey. 2009. Longitudinal analysis of public response to wildland fire and fuel management: A study to evaluate change and predict citizen behaviors in agency decision processes. Joint Fire Science Research Report. Oregon State University, Corvallis, OR.

Shindler, B., E. Toman, S. McCaffrey. 2009. Future research needs in social science for wildland fire management agencies. Joint Fire Science Program Advisory Report.

Shindler, B., E. Toman, and S. McCaffrey, 2009. Profile of Study Participants: Summary of Findings #1. Longitudinal analysis of public response to wildland fire and fuel management: A study to evaluate change and predict citizen behaviors in agency decision processes. Joint Fire Science Research Report. Oregon State University, Corvallis, OR.

Shindler, B., E. Toman, and S. McCaffrey, 2009. Citizen Preferences for Fuel Management Practices: Summary of Findings #2. Longitudinal analysis of public response to wildland fire and fuel management: A study to evaluate change and predict citizen behaviors in agency decision processes. Joint Fire Science Research Report. Oregon State University, Corvallis, OR.

Shindler, B., E. Toman, and S. McCaffrey, 2009. Agency Communication Methods and Citizen-Agency Interactions: Summary of Findings #3. Longitudinal analysis of public response to wildland fire and fuel management: A study to evaluate change and predict citizen behaviors in agency decision processes. Joint Fire Science Research Report. Oregon State University, Corvallis, OR.

Interactive Workshops/Courses

Toman, E. 2009. Public perspectives of fire, fuels, and the Forest Service in the Great Lakes Region: a longitudinal survey of residents in Michigan, Minnesota, and Wisconsin. Presentation at the Midwest Jack Pine Symposium. August 25-26, 2009. Odanah, WI.

McCaffrey, S. 2009. Course RX510—NAFRI. Tucson, AZ.

McCaffrey, S. 2009. Technical Fire Management. Washington Institute. Bothell, WA.

Shindler, B. 2007. Citizen expectations of federal agencies for fire and fuel management. Changing Facets of Forest Communities Workshop. Society of American Foresters. Bend, OR.

Shindler, B. 2009. Social science fire research in the United States. Research Update Workshop. Charles Sturt University. New South Wales, Australia.

Shindler, B. 2008. People, politics, and fire management: forest agency and community perspectives. Spotlight on Science: Sharing Research with Partners Workshop. BLM, USGS, USFS, and USFWS. Portland, OR.

Refereed Research Publications

Shindler, B., E. Toman, and S. McCaffrey. 2009. Public Perspectives of Fire, Fuels, and the Forest Service in the Great Lakes Region: A Survey of Citizen-Agency Communication and Trust. *International Journal of Wildland Fire*. 18: 157-164.

Toman, E., B. Shindler, J. Absher, and S. McCaffrey. 2008. Post-fire communications: The influence of site visits on public support. *Journal of Forestry*. 106(1): 25-30.

Olsen, C. and B. Shindler. 2007. *Citizen-agency interactions in planning and decision-making after large wildfires*. USDA Forest Service General Technical Report, PNW-GTR-715. Pacific Northwest Research Station, Portland, OR

Shindler, B. 2006. 2006. Public acceptance of wildland fire conditions and fuel reduction practices: challenges for federal forest managers. Chapter in: *Humans, Fires, and Forests*. T. Daniel, P. Jakes (eds.). Corvallis, OR: Oregon State University Press.

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Toman, E., B. Shindler, and M. Brunson. 2006. Fire and fuel management communication strategies: Citizen evaluations of agency outreach programs. *Society and Natural Resources*. 19: 321-336.

Toman, E. and B. Shindler. 2006. Communicating the wildland fire message: influences on knowledge and attitude change. In: *Fuels management—how to measure success*. P. Andrews and B. Butler (eds.). Conference Proceedings RMRS-P-41. Fort Collins, CO: USDA Forest Service Rocky Mountain Research Station.

Olsen, C. and B. Shindler. *In press*. Trust, acceptance, and citizen-agency interactions after large fires: influences on planning process. *International Journal of Wildland Fire*.

Conference Presentations

McCaffrey, S., B. Shindler, and E. Toman. 2009. Public views of fire management from prescribed fire to suppression. 4th International Fire Ecology & Management Congress, Savannah, GA, December 2009

Shindler, B. 2009. Public acceptance of fuel reduction strategies: the U.S. experience. Presentation at the workshop on bushfire management strategies in SE Australia. August 6, 2009, Charles Sturt University. Albury, NSW

Shindler, B. and C. Olsen. 2008. Community planning in post-fire environments. International Symposium for Society and Resource Management. University of Vermont. Burlington, VT.

Toman, E., B. Shindler, and S. McCaffrey. 2008. Homeowner implementation of fuel treatments: A longitudinal analysis of factors contributing to adoption and maintenance. 14th International Symposium on Society and Resource Management. Burlington, Vermont.

Shindler, B. 2008. Citizen-agency interactions for post-fire planning. The Scientific Foundations of Post-fire Policy Workshop. Oregon State University. Corvallis, OR

Shindler, B. and R. Gordon. 2007. Communication strategies for fire management. International Association of Wildland Fire Conference-The Fire Environment-Innovations, Management, and Policy. March 26-30. Destin, FL.

Toman, E. and B. Shindler. 2007. Wildland fire and fuel management: A framework for effective communication. 13th International Symposium on Society and Resource Management. Park City, Utah. June 2007.

Shindler, B. 2006. Fire and fuels management at the wildland-urban interface. Keynote Speaker: Australasian Fire Authorities Council Symposium. Melbourne, Australia.

Toman, E. and B. Shindler. 2006. "Communicating the wildland fire message: Influences on knowledge and attitude change." 1st Fire Behavior and Fuels Conference. Fuels Management—How to Measure Success. International Association of Wildland Fire.

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