Longitudinal Analysis of Public Response to Wildland Fire and Fuel Management: Examining Citizen Responses and Fire Management Decisions from 2002-2008

Thesis

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Abstract

Wildland fire is one of the foremost land management issues impacting both public and private resources throughout the United States. Since 2000, the average annual acres burned nearly doubled from the previous decade (National Interagency Fire Center 2010). The human population within the wildland-urban interface (WUI) has increased greatly while a century of national fire suppression policy has allowed adjacent fuel levels to reach unprecedented levels. In the midst of this volatile and high stakes situation, public land managers are tasked with implementing fuel reduction programs designed to reduce the excessive forest vegetation that can lead to catastrophic wildfires and threaten communities. Public acceptance is an essential element to successful implementation of fuel management activities. This longitudinal study examined public opinion of agency fuel reduction strategies in seven states (AZ, CO, OR, UT, MI, MN, WI) over a six-year period (2002-2008). Responses provide information on citizen support and contributing factors and allow examination of differences between locations and over time. The study also examined the decision-making environment of fire managers in the three lake states where fuel management programs were in early stages of development. These findings provide descriptive information about the types of treatments used, management objectives, and the factors that influence fuel management decisions in these locations.

Dedication

Dedicated to our nation's wildland firefighters.

Acknowledgments

The completion of this project would not have been possible without the patience and support of many individuals. I would like to thank my advisor, Dr. Eric Toman, for his outstanding guidance, support, and leadership throughout this process. I also wish to thank my graduate advisory committee members, Dr. Tom Koontz and Dr. Robyn Wilson, for their advice and recommendations. I would like to acknowledge the administrative staff of the School of Environment and Natural Resources for all of their help and support. I would like to thank the Joint Fire Science Program for project funding and the citizens and wildland fire managers in Arizona, Colorado, Oregon, Utah, Michigan, Minnesota, and Wisconsin who were willing to participate in this research. I wish to thank my wife, Katie, for her unwavering love and support and my parents for teaching me the value of hard work and perseverance. I also wish to thank Mark Giese, Amy Schmidt, Dr. Jerry Bigham, Dr. Neil Andrew, Dr. David Hix, Dr. Charles Goebel, Dr. R. Gregory Corace III, Dr. Bruce Shindler, and each and every professor who shared with me their valuable experience and insight.

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Chapter 1: Introduction

HISTORICAL PERSPECTIVE

Wildland fire is one of the foremost land management issues affecting both public and private resources throughout the United States. A century of fire exclusion, grazing by domestic livestock and widespread establishment of exotic species have altered fire regimes, fuel loadings, and vegetation composition and structure (Barrett et al. 1991, Brown et al. 1994, Ford and McPherson 1999). Indeed, it is estimated that fire regimes on over half of all federal and non-federal lands (excluding agricultural, barren, and urban/developed lands) have been moderately or significantly altered from their historical range (Schmidt et al. 2002). 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). Persistent regional drought conditions coupled with the recent trend of long, hot fire seasons have combined to create a volatile situation that places an enormous burden on collective fire management resources. At the same time, a recent analysis of the Wildland Urban Interface (WUI), where structures and other human developments meet or intermingle with wildland vegetation, found a 10.9% growth in total area and a 17.6% growth in housing units from 1990-2000 in California, Oregon, and Washington alone (Hammer et al. 2007). This

increasing human dimension adds an additional layer of complexity to the equation, meaning that many wildfires previously considered "remote" now have the potential to impact homes and entire forest communities.

In recent years, scientific inquiry and landscape observation have shed considerable light on the critical role of fire in maintaining healthy forest ecosystems. Fire disturbance in most forest regimes is now better understood as playing a vital role in sustaining ecosystem integrity and biodiversity (Beschta et al. 2004). 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).

Furthermore, 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).

Land management agencies are increasingly tasked with implementing comprehensive fuel reduction programs with multiple objectives including 1) restoring over-stocked forests to within the range of historical variability, 2) reducing the accumulation of available fuel from forest environments, and 3) promoting the adoption and maintenance of defensible space programs by forest residents.

Multiple factors will influence the ability to achieve these objectives. Two issues of particular importance to successful restoration of forest conditions and reduction of

fire risk include 1) improved understanding of the factors that influence public acceptance of management practices (e.g. prescribed fire, thinning, mechanical vegetation removal) used to treat forest fuels, and 2) development and communication of relevant scientific information to support comprehensive fuel management programs that are appropriate for the ecological, social, and political characteristics of a particular region.

MANAGEMENT CONTEXT

Issue 1: Public Acceptance of Fuel Management Programs.

In order to proactively accomplish the overarching objective of decreasing the public's risk to wildfire, agencies are designing and implementing comprehensive fuel reduction programs that include the utilization of forest management practices such as prescribed fire, thinning, and mechanical vegetation removal. Because a major objective of these programs is to reduce the risk of wildfire to those living in forest communities, there is a strong human component inherent in the process. The fuel reduction solution is much more complex than simply lighting a match or starting a chainsaw. Many of these projects are conducted on public land located immediately adjacent to communities within the WUI; thus, treatments receive a high level of scrutiny from public stakeholders.

While residents in forest communities enjoy the benefits of such treatments, they also bear the costs of any negative impacts ranging from smoke or damage to private property to altered stand composition and changing forest values. Given such conditions,

fuel treatment programs require a supportive local constituency to be successful (e.g., Shindler and Toman 2003, Brunson and Shindler 2004). Regardless of how well conceived a particular fuel reduction program may be from a technical standpoint, implementation of these treatments will be difficult in the absence of public support. From a management perspective, understanding the factors that influence public acceptance of fuel management programs has the potential to pay large dividends on the ground by creating a roadmap of principles on which to focus for success.

To date, research suggests acceptance is influenced by multiple factors including awareness of potential outcomes (e.g., Loomis et al. 2001, Brunson and Shindler 2004), citizen involvement in developing treatment plans (e.g., Winter et al. 2002, Blanchard and Ryan 2007), existence of high quality relationships between residents and agency personnel (Fleeger 2008), trust in agency managers (e.g., Shindler and Toman 2003), as well as situationally specific variables (e.g., size of treatment, proximity to homes, weather conditions, etc., Winter et al. 2002).

Issue 2: Exchange of Fire Science Information.

Fire and fuel management are complex issues that involve multiple ecological as well as social variables. Moreover, treatment programs vary in application depending on site-specific variables such as forest ecotype, climate, fire season, WUI population, and acres to manage, among others. There is certainly no one-size-fits-all approach to fuel management that is effective or appropriate in every situation. Effective management activities will be based on unique local conditions (ecological, social, and political) and

current, relevant information compiled and shared among management colleagues, professional societies, as well as agency and research scientists.

It is critical that management professionals have established methods to access available and emerging information to support their management decisions. While valuable information may be available, this availability does not necessarily mean it is communicated in the manner most effective to support decision-making (National Research Council 2009).

The process of making this type of information useful and relevant for practical decision making is known as decision support. Understanding the factors that promote effective information exchange and decision support activities will provide managers with the opportunity to develop contemporary, effective management plans based on scientific information applicable to their situation. To date, research suggests decision support activities are most successful when research is based primarily on end users' needs rather than scientific research priorities, communication is collaborative and ongoing between information producers and information users, a strong leader is present to shepherd and guide the overall decision support process, and decision support networks are able to function in a long-term capacity, rather than via short term interactions (National Research Council 2009, Zand 1997).

PROJECT OVERVIEW

As the above discussion illustrates, public acceptance and effective information exchange are critical to the development and implementation of successful fuel

management programs. This study provides a rare perspective on the issue of public acceptance by completing a longitudinal analysis of citizen responses across a six-year study period (2002-2008) in seven locations (Arizona, Colorado, Oregon, Utah, Michigan, Minnesota, and Wisconsin). Findings, thus, enable comparisons across time—to identify changes in citizen responses and analyze influencing factors—and between geographic locations—to recognize commonalities as well as key differences in citizen responses. In addition, the study examines the decision-making environment of fire managers in the three lake states (MI, MN, WI). The project is centered around the following research objectives:

1. To identify and analyze citizen support for fuel management practices (particularly prescribed fire and mechanical vegetation removal) over time (2002-2008) and across locations (AZ, CO, OR, UT, MI, MN, WI).
2. To examine the factors (e.g., awareness, trust, citizen-agency interactions) that influence public acceptability of fuel management programs.
3. To explore the decision-making environment of fire managers and examine the factors that influence their decisions (e.g., availability of information and tools, institutional constraints, perceived attitudes of public stakeholders).

CONCLUSION

The extent of fire activity has increased in recent years and now affects a growing number of individual homeowners and entire forest communities in many regions across the United States. Forest fuels have reached unprecedented levels that serve to increase

fire severity and decrease forest health. Public agencies have adopted fuel management programs designed to proactively counteract this dangerous situation and fire managers must evaluate available tools and local conditions and implement the most appropriate fuel reduction strategy for their management unit. This study is designed to evaluate the public acceptance of these fuel management programs by examining public responses over time and across geographic locations while also exploring the decision-making environment of fire managers in a subset of locations as they build fire management programs. Findings reflect the perspectives of citizens who live adjacent to public forestlands and the fire managers who strive to keep them safe–both critical stakeholders in the context of wildland fire management. This study provides a direct link to the field of natural resources as the findings will help identify public acceptance of agency programs, factors that influence their acceptance over time, and the tradeoffs and factors weighed by managers as they develop programs to reduce forest fuels and restore the ecological health of public forest resources.

Chapter 2: Longitudinal Analysis of Public Response to Wildland Fire and Fuel Management

INTRODUCTION

Wildfire impacts have increased in extent and severity in recent years. The average annual acres burned from 2000 to 2009 (6.1 million acres) is nearly double that of the 1990's (3.3 million acres) and a total of more than 8 million acres have burned in four separate years since 2000 (National Interagency Fire Center 2010). In addition to the striking increase in amount of acres burned, there has been a trend toward larger fires (Calkin et al. 2005). While the annual number and average size of fires is on the increase, a recent analysis of the Wildland Urban Interface (WUI), where structures and other human developments meet or intermingle with wildland vegetation, found a 10.9% growth in total area and 17.6% growth in housing units from 1990-2000 in California, Oregon, and Washington alone (Hammer et al. 2007). This increasing human dimension adds an additional layer of complexity to the equation, meaning that many wildfires previously considered "remote" now have the potential to impact homes and entire forest communities.

Fires that occur in the WUI can be particularly catastrophic, as evidenced by several recent examples. In 2002, the Hayman Fire in Colorado and the Rodeo-Chediski Fire in Arizona destroyed a combined 1,026 structures (National Interagency Fire Center

2010). In 2003, 2,400 structures were burned during a single California fire (the Cedar Fire) while a series of wildfires in autumn 2007 forced an estimated 1 million residents to evacuate their homes. These and other examples demonstrate the high stakes that are in play when wildfires occur within and adjacent to areas of human population (WUI).

Over the last few decades, wildland fire policy in the U.S. has increasingly emphasized proactive efforts to reduce the likelihood of fire (Stewart et al. 2006). The use of fuel treatments, such as prescribed fire and mechanized thinning, is a primary approach used to reduce fuel levels on public lands. As research has recognized, citizen support is a basic requirement to project implementation and long-term success of fuel treatment programs (e.g., Manfredo et al. 1990, Shindler and Toman 2003). At the local level, such support is critical to implementing treatments on public lands, particularly in those areas adjacent to forest communities.

A growing body of research provides evidence of increasing support for the use of fuel treatments in many regions of the U.S. (e.g., Manfredo et al. 1990, Winter et al. 2002, Brunson and Shindler 2004, Blanchard and Ryan 2007). However, most of these studies consist of data collected at a single point in time. Resulting data provide a "snapshot" of a cross-section of the population at one specific point in time. Although careful analysis of cross-sectional data can provide considerable insight, there are limitations in our ability to understand ongoing processes with data collected from a single reference point (Babbie 1995). To overcome these limitations, longitudinal research designs provide for the collection and analysis of responses over time.

To date, few longitudinal studies have been completed on wildland fire. McCool and Stankey (1986) completed a trend analysis of users of the Selway-Bitterroot

Wilderness Area (following up on Stankey's original 1976 study). Results demonstrated increased awareness of the effects of wildland fire on forest ecosystems as well as increased support for the use of fire in management activities. More recently, Shindler and Toman (2003) completed a panel study of residents in northeast Oregon and southeast Washington communities five years after a previous study. While findings showed citizen acceptance of both prescribed fire and mechanized thinning treatments had remained relatively stable across the study period, they also revealed a declining relationship between participants and resource managers. This finding was particularly critical given the strong correlation between positive citizen-agency relationships and acceptance of fuel management activities. These studies demonstrate the value of longitudinal studies to examine how people react to changing conditions and test how specific variables contribute to their response to agency fire and fuels programs over time.

This study is designed to begin to fill the existing research gap by completing a longitudinal analysis of residents in seven different study locations. The study replicates research originally conducted in Arizona, Colorado, Oregon, Utah, Michigan, Minnesota, and Wisconsin in 2002. The follow-up study was conducted in 2008 using the same measures and participants; where appropriate, new questions were added in 2008 to reflect current management challenges. The purpose of this study was to examine acceptance of agency fuel treatment activities, factors that contribute to citizen support, and compare responses over time and between locations.

Management and Research Context.

Throughout much of the previous century federal fire policy was directed at excluding fire from the landscape. In many locations, fire exclusion and traditional management practices have 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.

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 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). 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.

Second, these policies recognize the wildland fire problem is extensive and solutions will require an unprecedented degree of interaction 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 tools used by managers to reduce the likelihood of fire.

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). In 1971, a study tested visitors on their knowledge of fire's effects upon the ecosystem in Montana's Selway-Bitterroot Wilderness (Stankey, 1976). Results of the true/false test indicated that the average visitor could correctly identify about half of the statements that related to fire's effects upon the ecosystem. However, the study found that greater fire knowledge related to an increase in support for less direct fire suppression activities. In 1989, a study surveyed individuals in the Montana-Wyoming region (the area most affected by the 1988 Yellowstone fires) and individuals from the rest of the nation (Manfredo et al. 1990). Five true-false questions were replicated from previous studies (Stankey 1976, McCool and Stankey 1986). Results suggested that as knowledge about fires and fire policy increased, support for prescribed fire policy also increased. These findings have been verified in more recent work (Loomis et al. 2001, Parkinson et al. 2003, Shindler and Toman 2003). For example, in their 2000 survey of residents in the Blue Mountains of eastern Oregon and Washington, Shindler and Toman (2003) identified a strong direct relationship between knowledge level and support for both prescribed fire and mechanized thinning. The more knowledgeable individuals were about a practice, the more likely they were to support its use.

In addition, 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 in recent years, an increasing number of citizens recognize the role of fire on the landscape (McCool and Stankey 1986, Loomis et al. 2001, Shindler and Brunson 2003). McCool and Stankey (1986) returned to the Selway-Bitterroot Wilderness to re-sample visitors about their perceptions and attitudes toward fire. Results showed that the public had grown more knowledgeable about fire's effects and correctly answered 64% of the true/false questions, compared to 53% in 1971. Results also showed that seven out of ten visitors supported letting fires burn in wilderness areas, compared to 38% in their original study. In their survey of Florida residents, Loomis et al. (2001) found strong support for the use of prescribed fire as a management tool and also concluded that this support could be increased by the introduction of educational materials that explained the beneficial aspects of prescribed fire.

In addition to citizen knowledge, findings across several locations indicate that acceptance of fuel treatments is influenced by multiple factors including awareness of potential outcomes (e.g., Loomis et al. 2001, Brunson and Shindler 2004), citizen involvement in developing treatment plans (e.g., Winter et al. 2002, Blanchard and Ryan 2007), existence of high quality relationships between residents and agency personnel (Fleeger 2008), trust in agency managers (e.g., Shindler and Toman 2003), as well as situationally specific variables (e.g., size of treatment, proximity to homes, weather conditions, etc., Winter et al. 2002).

In their survey of citizens in Arizona, Colorado, Oregon, and Utah, Brunson and Shindler (2004) found that acceptability judgments about prescribed fire were

significantly influenced by cognitive beliefs about the effectiveness of this tool in influencing wildfire intensity and frequency, and by affective responses to concerns about scenic quality and increased smoke levels. For mechanical vegetation removal, acceptability judgments were significantly influenced by cognitive beliefs about the effect of this practice on wildfire intensity or frequency and fuel loads. Additional analysis showed that acceptability judgments themselves were inter-correlated, meaning that persons who found prescribed fire to be acceptable also tended to find mechanical treatment acceptable.

Blanchard and Ryan (2007) surveyed citizens in Massachusetts and found that previous experience with wildland fire and knowledge about different fire management strategies were important factors that influenced support for fire hazard reduction strategies. In addition, participants in the study strongly supported involving the public in fire planning efforts, with questions about public participation in fire management planning receiving the highest ratings of any in the survey.

Fleeger (2008) examined the factors leading to the successful development and implementation of the Sitgreaves Community Wildfire Protection Plan (CWPP) in Arizona's White Mountains. He concluded that several key factors in the process were the commitment of the local forest agency to engage in collaborative processes with forest residents, share their technical expertise, and build positive working relationships with stakeholders. The multijurisdictional planning process established procedures for mitigating wildfire risk in the WUI, including the use of fuel treatment practices.

Citizen trust in agency managers is also an important factor influencing support for fuel treatment practices. Indeed, Shindler and Toman (2003) found that, among all

variables tested, trust in the forest agency to implement a responsible and effective fire program held the strongest association with support for prescribed fire utilization.

Finally, situationally specific variables have been shown to influence support for treatment practices. In their focus group study of residents in California, Florida, and Michigan, Winter et al. (2002) found that support for treatments was influenced by specific factors such as the size of the treatment, the degree of planning that preceded implementation, the amount of resources (human, equipment, and fiscal) available to the managing agency, and the proximity of the fuel treatment to developed areas.

While much has been learned from this prior research that can help inform fire and fuel management, most of the prior research has consisted of studies conducted in one location at a single point in time. The study reported here extends this prior research by replicating measures across a six-year study period in seven locations. 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.

RESEARCH DESIGN

In 2002, mail surveys were sent to a random sample of participants in seven locations (AZ, CO, OR, UT, MI, MN, WI). 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

(MI, MN, WI) was drawn from counties adjacent to National Forest land. Of the 2,686 surveys that were delivered, 1,325 responses were completed for a 49% response rate.

The follow-up survey was based on the 2002 questionnaire resulting in the replication of several measures, and also included additional variables to examine emerging issues at each location. These new questions were developed based on interviews conducted with resource managers in each location as well as a review of similar studies as reported in the literature since the 2002 survey. Questions included Likert-type scales and closed-choice question sets as well as semantic differential scales requiring respondents to choose between two opposing statements associated with fire and fuel management decisions. 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. After two weeks, a reminder postcard was sent to all participants who had not yet replied. Complete packets were sent again to all non-respondents, two more times at two-week intervals. After accounting for respondents who had moved from the study regions or were unable to complete the follow-up survey (they were deceased or incapacitated), a combined total of 1000 individuals remained in the sample for 2008. Of these, 546 completed the survey for a 55% overall response rate (see *Table 2.1*).

Data analysis 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

Study Locations (relevant management units)		2008 adjusted sample	2008 completed surveys	2008 response rate
AZ	Yavapai County (Prescott National Forest)	111	59	53%
CO	Boulder and Larimer Counties (Rocky Mountain National Park, Arapahoe-Roosevelt NF)	121	71	59%
OR	Deschutes and Jefferson Counties (Deschutes NF, Bureau of Land Mgmt Prineville District)	122	71	58%
UT	Salt Lake City and Tooele County (BLM West Desert District, Uinta-Wasatch-Cache NF)	134	68	51%
MI	All communities adjacent to national forests (Huron Manistee NF, Ottawa NF, Hiawatha NF)	151	81	54%
MN	All communities adjacent to national forests (Chippewa NF, Superior NF)	179	99	55%
WI	All communities adjacent to national forests (Chequamegon-Nicolet NF)	181	96	53%
Total		**1000**	**545**	**55%**

Table 2.1. Study Locations

analysis. This enabled assessment of change in individual responses between 2002 and 2008. Chi-square tests, which are robust against differences in sample size (Cohen and Lea 2004), were used to compare responses across study locations. In the following section, significant differences between locations and over time are indicated in the presented results. The results section finishes with a presentation of correlations and logistic regression models designed to examine the influence of contributory factors on participant acceptance of prescribed fire and mechanized thinning treatments.

FINDINGS

Summary of participants.

Table 2.2 provides an overview of several key respondent characteristics. The majority of study participants were adult males with a median age of 62. Fewer than half had completed a bachelor's degree. A majority of participants in all western states reported fire activity in their area during the study period, with a high of 93% in Utah. Results on this item were significantly different across locations; however, more than one-fourth in every state acknowledged a wildfire had occurred in their area in the previous six years. As for impacts from these fires, most indicated they experienced some discomfort from smoke, but few respondents were evacuated (9% in AZ, 7% in OR, 5% in MN, 4% in CO), and none experienced any damage to their property. Overall, a majority also indicated that their local forests were healthy; however, significant differences on this response were observed across geographic locations. Among residents

	2008[a]
Gender (% male)	78
Median Age (years)	62
Percent with 4 year degree	44**
A wildfire occurred in the area during the study period (% yes)	56**
Forest health (% rating local forest as very/somewhat healthy)	62**
Estimated distance from home to an area where fire might burn (miles)	3.5
Environmental/Economic Orientation (mean score)	3.7

** 2008 responses are significantly different between locations at $p \leq .05$.

[a] Displaying overall results across all study locations.

Table 2.2. Summary of Study Participants

of the lake states, the number who rated their forests as healthy was 79% in Wisconsin, 76% in Minnesota, and 73% in Michigan. In contrast, Colorado residents rated their forests as the *least healthy* among the seven states surveyed with a solid majority (69%) classifying their public forests as *unhealthy*.

In both 2002 and 2008, respondents were asked to estimate the distance from *their home* to a natural area where a wildfire might burn. Participants lived close to natural areas in all locations, with a mean distance of 3.4 miles in 2002 and 3.5 miles in 2008. Across all states, average distances varied from a low of just over 2 miles in Minnesota and Wisconsin to just under 6 miles in Utah. Estimates were generally similar across the study period. It is noteworthy that although the western United States receives greater attention in terms of fire activity, in 2008 residents of Minnesota and Wisconsin reported the closest distance from their homes to an area where wildfire might occur (with nearly three-fourths indicating such an area was directly adjacent to their property). Even in Utah, which had the highest average distance, 70% of participants indicated they were within 5 miles of where a wildfire might burn.

Lastly, given the economic and environmental tradeoffs often associated with managing public natural resources, participants indicated their preference for agency management decisions on a 7-point scale developed by Shindler et al. (1993) ranging from 1 (priority given to environmental conditions even if there are negative economic consequences) to 7 (priority given to economic considerations even if there are negative environmental consequences); with responses at the midpoint seeking a balance between environmental and economic considerations. Responses slightly favored priority be given to economic considerations; however, the most common selected response was the

midpoint indicating that management decisions should strike a balance between environmental and economic factors.

Perceived likelihood of wildfire.

Respondents were asked to evaluate the likelihood of a wildfire occurring near their home within the next five years on a 4-point scale ranging from "very likely" to "very unlikely". Responses in *Table 2.3* demonstrate that a strong majority overall in both 2002 (67%) and 2008 (63%) believed a fire was somewhat or very likely to occur.

Significant differences. Responses differed across geographic regions. In 2008, at least 80% in each western state indicated a fire was likely to occur. Responses in these states ranged from a high of 87% in Oregon to a low of 80% in both Arizona and Colorado. In contrast, significantly fewer residents in the lake states believed a fire was equally likely to occur near their home. Responses ranged from a high of 50% in Michigan to a low of 35% in Minnesota. In aggregate responses, participants indicated the likelihood of a future wildfire in their area significantly decreased from 2002 to 2008.

Statement	Very Likely	Somewhat Likely	Somewhat Unlikely	Very Unlikely	Mean Score*
*How would you rate the likelihood that a wildfire could occur in the forests or rangelands near your home in the next five years?***					
2002	31%	36%	19%	9%	2.05
2008	25%	38%	22%	11%	2.18

* 2002 and 2008 responses are significantly different at $p \leq .05$.

** 2008 responses are significantly different between locations at $p \leq .05$.

"Don't Know" responses are omitted for presentation purposes.

Table 2.3. Citizens' perceived likelihood of a local wildfire event

Attitudes about treatments.

Responses in *Table 2.4* show that overall support for prescribed fire and mechanized thinning remained relatively high and stable throughout the study period. For each treatment, participants selected one of four options regarding their acceptance of treatment use. Overall, in 2008 85% of respondents supported some level of prescribed fire use; 44% believed the local forest agency should have full discretion for its use, while an additional 41% said the agency should use prescribed fire only in carefully selected areas. A similar number supported mechanized thinning with nearly two-thirds giving agency managers full discretion for its use.

Significant differences. Significant differences were observed across study locations. In 2008, substantially more participants in Arizona and Oregon (at least 60% in each location) were willing to give managers full discretion to use prescribed fire than

	Prescribed Fire**		Mechanized Thinning	
Statement	2002	2008	2002	2008
The use of fuel treatments on public forests and rangelands…				
Is a legitimate tool that resource managers should be able to use whenever they see fit	45%	44%	59%	62%
Is something that should be done infrequently, only in carefully selected areas	45	41	26	24
Is a practice that should not be considered because it creates too many negative impacts	3	5	3	2
Is an unnecessary practice	2	2	3	2

** 2008 responses are significantly different between locations at $p \leq .05$.

"Don't Know" responses are omitted for presentation purposes.

Table 2.4. Public acceptability of fuel reduction practices

respondents in other locations. Also in 2008, a majority in each state gave managers full discretion to use mechanical treatments. Scores for this option ranged from 50% agreement in Michigan to 75% in Arizona. Across the study period, responses remained similar for prescribed fire while there was a slight overall increase in acceptance of mechanized thinning.

Concerns with use of prescribed fire.

While fuel reduction treatments are designed to reduce the potential for a wildfire, the treatments themselves have the potential to result in negative outcomes. Participants were asked to indicate their level of concern with eight potential risks associated with the use of prescribed fire on a 4-point scale ranging from "not a concern" to "great concern" (see *Table 2.5)*. The particular risks noted here had been identified as concerns in previous research and included items ranging from the loss of wildlife habitat to damage to private property and decreased recreation opportunities.

Significant differences. The chi-square test indicated significant differences between locations on five of the eight risks. Michigan residents showed the highest level of concern for three of these risks, while Arizonan's generally exhibited the fewest concerns. In aggregate responses, concern about six of these eight potential risks declined significantly across the study period. Concerns over *increased soil erosion, damage to private property*, *deteriorated public water supply,* and *decreased recreation opportunities* declined by double-digit margins. Concerns with only one item, the *economic loss of useable timber*, increased between 2002 and 2008.

Statement	2002	2008	P-value
Please indicate how concerned you are about the following possible effects of prescribed fire.			
Increased levels of smoke**	44%	40%	0.014
Loss of wildlife habitat*	43	39	0.001
Increased soil erosion**	49	39	0.000
Economic loss of useable timber	35	38	0.071
Reduced scenic quality	40	35	0.053
Damage to private property**	47	32	0.000
Deteriorated public water supply**	37	25	0.000
Decreased recreation opportunities**	35	19	0.000

* 2002 and 2008 responses are significantly different at $p \leq .05$.
** 2002 and 2008 responses are significantly different at $p \leq .05$. and 2008 responses are significantly different between locations at $p \leq .05$.

Data reflect percentage of respondents who rated concern as great/moderate on a four-point scale (none, slight, moderate, great).

Table 2.5. Concerns with the use of prescribed fire

Trust in forest agency.

In 2008, participants indicated their level of trust in their local forest agency to respond to forest fires and implement specific fuel reduction treatments on a 7-point scale ranging from "strongly disagree" to "strongly agree". Results are displayed in *Table 2.6* and have been condensed for presentation purposes (responses of 1 - 3 = disagree, responses of 4 = neutral, responses of 5 - 7 = agree). In aggregate, a majority of respondents expressed trust in their local forest agency's ability to fulfill the historical role of fire suppression (*trust the agency to respond to and fight forest fires*). However, respondents expressed less trust in their local agency's ability to use treatment practices on the ground, with just a slight majority agreeing that they trusted the agency to effectively plan and implement prescribed burns.

Statement	Agree	Neutral	Disagree	Mean Score
I trust the forest agency in my area to…				
Respond to and fight forest fires**	83%	11%	5%	5.7
Use thinning practices effectively	64	21	14	5.0
Effectively plan and implement prescribed burns	57	20	21	4.6
** 2008 responses are significantly different between locations at $p \leq .05$.				

Table 2.6. Trust in forest agency to implement specific treatment

Significant differences. On one item, *I trust the forest agency in my area to respond to and fight forest fires,* significant differences were observed between locations in 2008. Specifically, citizens from Arizona and Utah were more likely to agree with this statement, with 90% indicating that they trusted their local agency to fulfill this responsibility. Furthermore, 60% of Arizonans selected "strongly agree" on this item, indicating the highest level of trust possible. In contrast, 71% of Michigan respondents trusted their local agency to respond to and fight forest fires, with just 27% willing to say that they "strongly agree".

Citizen-agency interactions.

In 2008, the survey included a new line of questions regarding citizen experiences with federal forest managers. Citizens were asked to indicate their level of agreement with questions designed to evaluate the strength of local citizen-agency interactions on a 4-point scale ranging from "strongly disagree" to "strongly agree". Responses are presented in *Table 2.7* and are collapsed for presentation purposes. Most striking of these responses is the high number of participants who selected don't know for each item

Statement	Agree	Disagree	Don't Know
Managers do a good job of providing information about management activities	47%	21%	31%
Agency managers build trust and cooperation with local citizens**	47	20	33
The agency is open to public input and uses it to shape management decisions	47	19	34
There are adequate opportunities for citizens to participate in the local agency planning process**	37	23	40
I am skeptical of information from the forest agency in my area**	23	55	21
** 2008 responses are significantly different between locations at $p \leq .05$.			

Table 2.7. Citizen-agency interactions and trust

(ranging from 21% to 40%); suggesting a high number of participants have had little direct experience with forest agencies despite their proximity to federally managed lands. Moreover, responses provide a rather tepid assessment of citizen-agency interactions. In aggregate, just under half agreed forest agencies do a good job of providing information about management activities, that agency managers build trust and cooperation with local citizens, or are open to public input and use it to shape management decisions. Even fewer believed there were adequate opportunities for citizens to participate in agency planning processes at the local level. Moreover, nearly one quarter were skeptical of information received from forest agencies.

Significant differences. On three items, *managers build trust and cooperation with local citizens*, *there are adequate opportunities for citizens to participate in the local agency planning process*, and *I am skeptical of information from the forest agency in my area,* significant differences were observed across locations in 2008. The number of respondents agreeing with these statements ranged from a high of 56% in AZ to a low of

41% in MI (*managers build trust and cooperation with local citizens)*, from a high of 47% in CO to a low of 27% in UT (*there are adequate opportunities for citizens to participate in the local agency planning process*), and from a high of 31% in MN to a low of 18% in AZ (*I am skeptical of information from the forest agency in my area).*

Influencing variables.

Correlation analysis. One objective of this study was to identify and examine those variables that influence acceptance of treatment use. We first ran a correlation analysis to identify variables significantly associated with acceptance of treatments (see *Table 2.8*). While Steel et al. (1997) found that public attitudes about natural resource issues are often associated with socio-demographic characteristics, data here provided

Characteristic	Acceptance of Prescribed Fire	Acceptance of Mechanized Thinning
Age	0.005	-0.018
Gender	0.058	0.053
Education	0.095 *	0.086
Regional Location (Western vs. Lake States)	.109 *	.123 **
Perceived likelihood of wildfire	0.009	-0.039
Wildfire impacts on quality of life	0.074	-0.023
Distance to area where wildfire might burn	-0.003	-0.006
Environmental / Economic Orientation	0.063	.222 **
Trust in agency managers to implement specific treatment	.524 **	.336 **
Treatment outcomes (index variable)	.536 **	.408 **
Trust in agency information (index variable)	.293 **	.165 **
Agency interactions with local community (index variable)	.236 **	.095
Agrees that agency incorporates public concerns	.325 **	.142 **
* Significant at $p \leq .05$., ** Significant at $p \leq .01$.		

Table 2.8. Bivariate correlations between respondents' characteristics and support for prescribed fire and mechanized thinning, 2008 survey

limited evidence of influence on citizen acceptance of agency practices from demographic variables such as age (not significant), gender (not significant), or 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).

Several index variables were created and incorporated within the data analysis. To analyze the influence of geographic location on treatment acceptance, respondents from each of the seven states were re-coded into the "regional location" variable (with 1 representing AZ, CO, OR, UT and 2 representing MI, MN, WI). This variable was found to have a significant influence on acceptance for both treatments.

The "treatment outcomes" variable was created by combining responses to individual questions asking respondents to evaluate the likelihood that treatments would generate positive outcomes. Individual questions were evaluated using a Likert-type scale where 1 = not at all likely and 5 = extremely likely. When necessary, responses to individual questions were reverse-coded to maintain consistency in the scale of responses. Potential outcomes of prescribed fire included reducing scenic quality (reverse-coded), saving money by reducing the cost of fighting a wildfire, restoring forests to a more natural condition, improving conditions for wildlife, effectively reducing fire risk, and creating more smoke in the short term but less smoke over time. Potential outcomes of mechanized thinning included reducing scenic quality (reverse-coded), saving money by reducing the cost of fighting a wildfire, restoring forests to a more natural condition, improving conditions for wildlife, effectively reducing fire risk, and allowing for more harvesting than necessary (reverse-coded). The index was created

by combining responses to these six individual questions for each treatment; therefore, each respondent displayed an overall likelihood of the treatment resulting in positive outcomes that ranged from 6 to 30. Results show that treatment outcomes had a significant, direct influence on acceptance for both treatments.

The "trust in agency information" variable was created by combining responses to individual questions asking respondents to rate their trust in local agency information. Individual questions were evaluated using a Likert-type scale where 1 = strongly disagree and 7 = strongly agree. Questions included in the trust in agency information index variable evaluated respondents' belief that their agency provided credible information about fuel reduction activities, enough information to allow for actions to be taken about fire and fire safety, and current, timely information about forest fire issues. The index was created by combining responses to these three individual questions; therefore, each respondent displayed an overall level of trust in agency information that ranged from 3 to 21. Results show that trust in agency information had a significant, direct influence on acceptance for both treatments.

The "agency interactions with local community" variable was created by combining responses to individual questions (displayed in *Table 2.7*) asking respondents to evaluate the strength of local citizen-agency interactions. Individual questions were evaluated using a Likert-type scale where 1 = strongly disagree and 4 = strongly agree. When necessary, responses to individual questions were reverse-coded to maintain consistency in the scale of responses. Questions included in the variable evaluated citizen agreement with the following questions: the agency is open to public input and uses it to shape management decisions, agency managers create plans without input from local

communities (reverse-coded), managers build trust and cooperation with local citizens, managers do a good job of providing information about management activities, I am skeptical of information from forest agencies (reverse-coded), and there are adequate opportunities for citizens to participate in the agency planning process. The index was created by combining responses to these six individual questions; therefore, each respondent displayed an overall assessment of agency interactions with the local community that ranged from 6 to 24. Results show that agency interactions with the local community had a significant, direct influence on acceptance for prescribed fire.

Remaining variables that indicated a significant influence on one or both treatments included: environmental/economic orientation, trust in agency managers to implement specific treatments, and agreement that public concerns are incorporated into agency plans. Each of the variables that indicated a significant association with one or both treatments were included in the further analysis reported below.

Logistic regression. To explore the relative influence of the variables presented here on treatment acceptability, we dichotomized responses to the acceptability questions presented in *Table 2.4* (with 1 representing responses indicating the treatment is "a legitimate tool and should be used whenever managers see fit" or "something that should be used in carefully selected areas" and 0 representing all other responses --"a practice that should not be considered because it creates too many negative impacts", "an unnecessary practice", and "know too little to make a judgment"). We then used logistic regression to examine the influence of the eight independent variables that were significantly correlated with acceptance of prescribed fire and mechanized thinning

Variable	Acceptance of Prescribed Fire	Acceptance of Mechanized Thinning
	β (Sig.)	β (Sig.)
Education	.262 (.117)	-.133 (.431)
Regional Location (Western vs. Lake States)	-1.020 (.049) *	-.079 (.882)
Environmental / Economic Orientation	-.127 (.509)	-.038 (.844)
Trust in agency managers to implement specific treatment	.669 (<.001) ***	.369 (.047) *
Treatment outcomes Index: 6-30 (Belief that treatment will result in positive outcomes)	.299 (<.001) ***	.227 (<.001) ***
Trust in agency information Index: 3-21 (Trust in agency information)	-.045 (.557)	-.046 (.605)
Agency interactions with local community Index: 6-24 (Ratings of citizen-agency interactions)	.009 (.888)	.079 (.172)
Agrees that agency incorporates public concerns	.024 (.948)	.222 (.591)
Chi-square	118.085 ***	44.252 ***
Percent correctly classified	93.5	94.9
Nagelkerke R^2	0.575	0.316
Significance levels: *p ≤ .05; ***p ≤ .001		

Table 2.9. Logistic regression analysis

(displayed in *Table 2.8*). The resulting logistic regression models are presented above (*Table 2.9*).

The chi-square statistics for both models are statistically significant, indicating the combination of independent variables in the model significantly influence treatment acceptability. Each model was also successful in classifying at least 93% of cases. Also displayed is the Nagelkerke R^2, which provides an estimate of the variance predicted by

each model (Vaske 2008); the explained variance ranges from 57.5% for acceptability of prescribed fire to 31.6% for acceptability of mechanized thinning.

Despite the significant correlations reported in *Table 2.8*, five variables– "education," "environmental/economic orientation," "trust in agency information", "agency interactions with the local community," and "agreement that agencies incorporate public concerns"–did not significantly influence acceptance of prescribed fire or mechanized thinning treatments. The "regional location" variable significantly influenced acceptance of prescribed fire. Results show that support for prescribed fire was higher among respondents from the four western states (AZ, CO, OR, UT). Additionally, trust in agency managers to implement a specific treatment was significant in both models. Results indicate that as trust in the agencies' ability to implement a specific treatment increased, so did acceptance of its use. Finally, the treatment outcomes variable (belief that a specific treatment would result in various positive outcomes) was highly significant in both models; as the belief that a specific treatment would result in positive outcomes increased, so did acceptance of its use.

DISCUSSION

Findings here suggest that citizens in each location recognize the need for fuel reduction and are supportive of agency fuel programs. Additionally, and perhaps more importantly, this support remained consistent across the study period. Also, concerns with the use of prescribed fire decreased over time. Collectively, these findings provide evidence that citizens may be growing more comfortable with the use of fuel treatments

to mitigate wildland fire risk. They also suggest that this existing base of supportive stakeholders could be a central asset in building future management programs.

Results here also emphasize the importance of tailoring programs to address local needs. There were several notable differences in responses between locations on items including perceived health of local forests, strength of citizen-agency interactions, and attitudes about treatments. These differences 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.

While this research provides evidence of sustained acceptance for fuel treatments over time, trouble spots still exist. Findings here suggest low levels of trust in forest agencies to implement specific treatments on the ground. Indeed, more than one in five respondents in 2008 did not trust agency personnel to effectively plan and implement prescribed burns. This finding is particularly concerning given the strong connection between trust in agency managers to implement specific treatments and treatment acceptance, as evidenced in the correlation analysis and the logistic regression models.

Responses here also highlight frustration with a lack of opportunities for citizen involvement in agency planning and decision-making processes. The level of such concern varied between locations, but participants in each study site called for increased

participation over current levels. As responses here and elsewhere illustrate, citizens want an expanded role beyond what is typically available through standard scoping meetings.

A primary objective of this paper was to examine the factors that influence acceptance of treatments in the study locations. As suggested by prior literature, we expected treatment acceptance would likely vary across locations and would be influenced by multiple factors including awareness of potential outcomes (e.g., Loomis et al. 2001, Brunson and Shindler 2004), citizen involvement in developing treatment plans (e.g., Winter et al. 2002, Blanchard and Ryan 2007), existence of high quality relationships between residents and agency personnel (Fleeger 2008), as well as trust in agency managers (e.g., Shindler and Toman 2003). In addition, we were interested in the influence of demographic variables (age, gender, education), as well as other variables specific to this research such as environmental/economic orientation, distance from home to an area where a wildfire might burn, concern that a wildfire could impact quality of life, and perceived likelihood of a local wildfire event.

Our correlation analysis indicated significant associations between the potential explanatory variables and treatment acceptance levels at the 0.05 level on 8 of the 13 variables examined: education, regional location, environmental/economic orientation, trust in the agency to implement the specific treatment, belief that the treatment would result in positive outcomes, trust in agency information, ratings of agency interactions with the local community, and agreement that the agency incorporates public concerns. Interestingly, the correlations did not provide evidence that treatment acceptance is associated with the perceived likelihood of a local wildfire occurrence, concern that a wildfire could impact quality of life, or the distance from one's home to an area where a

wildfire might burn. The lack of observed association between these factors and treatment acceptance is noteworthy as it suggests that respondents' perception of a future wildfire impacting their life did not influence their acceptance of treatment practices designed to reduce the risk of future wildfires.

The further analysis of potential influencing factors through the logistic regression models identified three variables that significantly influenced treatment acceptance: regional location (significant in predicting acceptance of prescribed fire), trust in agency managers to implement specific treatments (significant in predicting acceptance of prescribed fire and thinning), and belief that treatments would result in various positive outcomes (significant in predicting acceptance of prescribed fire and thinning).

Prior research has uncovered regional variation in citizen concerns about the use of prescribed fire (e.g. Winter et al. 2002, Brunson and Shindler 2004). In this study, regional location was significant in predicting acceptance of prescribed fire treatments; specifically, support for this practice was more likely among respondents from the western states. This finding may be attributed to the higher frequency with which the practice is used in the western states and the fact that residents there have grown more comfortable with prescribed fire treatments and the outcomes that can be achieved.

Citizens in the lake states may be waiting to see if similar results can be achieved on their local forests before granting an equal level of support for the treatment; additionally, Michigan managers, specifically, must address negative public perceptions that persist partially as a result of prior mishaps with escaped prescribed burns (e.g. the 1980 Mack Lake Fire). These factors indicate that increased support in the lake states

may hinge largely on local managers' ability to use prescribed fire consistently, effectively, and responsibly.

The other two variables that were found to significantly influence treatment acceptance, trust in agency managers to implement specific treatments and belief that treatments would result in various positive outcomes, lend further credibility to earlier research that has identified trust in agency managers and beliefs about treatment outcomes as having an influence on treatment acceptability (e.g. Shindler and Toman 2003, Brunson and Shindler 2004). Given this growing body of knowledge, resource managers should think of building trust with stakeholders as a primary goal of agency programs and not simply expect it to result as a by-product of developing science-based management plans. Trust-building is a lengthy, cumulative process and trustworthy relationships are the sum of many individual interactions with local stakeholders. One mistake can replace a thousand successes and may result in the rapid erosion of trust, particularly when prescribed fire is the tool of choice. In the aftermath of an escaped prescribed burn in Utah in 2003, citizens indicated significantly lower levels of trust in the US Forest Service and Bureau of Land Management to make good decisions about wildfires and fire prevention (Brunson and Evans 2005). Trust must be built over time and will be a reflection not only of the strength of agency interactions with citizens, but also of the ability of agency managers to use treatments effectively on a consistent basis.

Regarding beliefs about treatment outcomes, these findings suggest that agency managers should take a proactive approach at reaching out to their stakeholders to communicate the positive results that can be achieved when fuel treatments are utilized effectively. Interactive communication approaches, such as conversations with agency

personnel, guided field trips, workshops, and informational sessions, may provide the type of venues necessary to not only communicate these outcomes to the public, but also build trustworthy relationships and establish credibility. Findings elsewhere indicate that interactive methods can be more effective at encouraging attitude or behavior change (Erwin 2001, Rogers 2003). In addition, trust is more likely to develop in the context of personal relationships than in anonymous information provision (Jamieson 1994). While it may be more efficient to use standardized, agency-wide communication devices, such approaches are unlikely to be as effective as messages that target local priorities and specific environmental context (Brunson and Shindler 2004). Given the important role of trust in agency managers and beliefs about treatment outcomes in influencing acceptability levels, the additional time required for agency managers to engage their stakeholders in more personal, interactive ways is likely to translate into positive outcomes at the local level.

CONCLUSIONS

Fuel reduction programs have become a key piece of the federal forest management puzzle across much of the nation. Because a major objective of these programs is to reduce the risk of wildfire to those living in forest communities, there is a strong human component inherent in the process. Therefore, public acceptance is critical to the long-term success and sustainability of effective fuel reduction programs.

This article describes a longitudinal study designed to develop a more complete understanding of the factors that contribute to public awareness and acceptance of agency

planning processes and fuel reduction treatments over time and across geographic locations. A central finding of this study is that, overall, public support for prescribed fire and mechanized thinning treatments remained relatively strong and remarkably stable throughout the study period in each of our locations. In addition, beliefs about most potential concerns associated with prescribed fire decreased from 2002 to 2008, both positive signs for land managers.

However, this study also shows that support is very much site-dependent and often hinges on the ability of individual managers to communicate effectively with forest residents while building credibility and providing opportunities for meaningful involvement in the management process. Additionally, findings highlight the critical link between trust in the agency to implement treatments, perceived treatment outcomes, and support for treatment methods. Armed with this information, managers have the ability to fine-tune their local outreach approach and focus not only on implementing effective treatments but also on building effective programs to engage local residents and strengthen those variables (e.g., public involvement, incorporating public concerns, trust building, communicating positive outcomes) that are shown to be related to treatment support.

Chapter 3: Examining the Decision-Making Environment of Fire Managers in the Northern Lake States

INTRODUCTION

The northern lake states region, comprised of the northern Lower and the Upper Peninsulas of Michigan, northern Wisconsin, and northern Minnesota, is dominated by a variety of forest ecosystem types characterized as fire-dependent (Drobyshev et al. 2008, Radeloff et al. 2001). These include: jack pine (*Pinus banksiana* Lamb.) forest ecosystem types, including pine barrens; upland mixed-pine forest ecosystem types dominated by red pine (*P. resinosa* Ait.) and eastern white pine (*P. strobus* L.); peatland forest ecosystem types dominated by black spruce (*Picea mariana*) and other woody plant species; as well as coastal pine forest ecosystem types distributed along the coasts of Lake Huron, Lake Michigan, and Lake Superior dominated by eastern white pine, red pine, jack pine and northern red oak (*Quercus rubra* L.).

The major organizations responsible for the management of these fire-dependent ecosystem types in the northern lake states are the US Forest Service, the US Fish and Wildlife Service, the National Park Service, the Bureau of Indian Affairs, state natural resource management departments, tribal entities, and non-profit organizations such as The Nature Conservancy. Efforts by managing agencies to reduce hazardous fuel levels and restore these forest ecosystems to more natural conditions are often complicated

by the need for managers to focus on multiple objectives as directed by guiding legislation such as the Multiple Use Sustained Yield Act of 1960 and the 1976 National Forest Management Act, among others. Management objectives commonly include the protection of wildlife habitat, commodity production, provision of recreational opportunities, and amenity values. In some instances these objectives may be complementary, while in others they involve difficult tradeoffs. Resource managers balance these multiple influences when making decisions about management activities. As these decisions have increased in complexity over time, managers have increasingly looked for additional information to understand potential outcomes of different management approaches.

The present paper describes a study designed to examine the decision-making context of fire managers in the northern lake states region (MI, WI, MN). We use in-depth interviews and a web-based survey of land managers in Michigan, Wisconsin, and Minnesota to understand 1) methods currently used to achieve forest restoration and/or fuel reduction objectives, 2) factors that influence decisions regarding the adoption of these different methods, and 3) availability of information exchange and decision support.

Summary of Related Research.

Tasked with implementing complex fire and fuel management programs, managers in the northern lake states region must rely on various forms of scientific information when making decisions. Often this information is generated by the academic community and may not be easily decipherable to the majority of fire managers. The term

"decision support", in a general sense, describes the process of making such scientific information useful and relevant for practical decision making (National Research Council 2009). The process is meant to provide tools, data, and other types of information products that make scientific information both accessible and understandable to decision makers on the ground. Recently, decision support has broadened to include a set of processes intended to create the conditions for the production and application of decision-relevant information. In this process, ongoing communication between the producers (scientific community) and users (management community) of information is critical to achieving the optimum outcome. Communication between information producers and users will likely be more effective when it is continuous and iterative, rather than a one-time, linear activity.

The effectiveness of decision support can be judged by the extent to which it increases the likelihood that decision-relevant information is produced and enables decision-makers to use it appropriately (National Research Council 2009). To increase effectiveness, prior research suggests several overarching principles that improve the effectiveness of decision support systems. Perhaps most importantly, decision support activities should be driven by users' needs, rather than scientific research priorities. Although this may seem intuitive, much research that is intended to be decision relevant is begun and conducted without consultation with the envisioned end users (McNie 2007; Sarewitz and Pielke 2007). This can lead to an outcome in which decision-makers feel as though the resulting information is not applicable to their situation.

Additionally, evidence emphasizes the importance of building strong, collaborative relationships between information producers and users, even to the extent

that relationship-building is a higher priority than the information products themselves. If interpersonal interactions are mismanaged, the resulting disconnects can reduce the quality of relationships between users and producers of information, the usefulness of information, and, ultimately, the quality of decisions (Mitchell et al. 2006, Reid et al. 2007).

Finally, decision support has been shown most effective when it continues over time rather than via short-term pilot projects or small, short-lived interactions between information producers and users. The element of time allows trust and relationships to strengthen and ideas to be fully investigated, thus providing decision-makers with a wealth of information designed specifically to address the unique questions important to their situation. Therefore, the formal institutionalization of a decision support system is often necessary to ensure longevity and maximize success (National Research Council 2009). Establishing focused decision support centers within or affiliated with academic institutions has been successful at the regional level (e.g. The Great Lakes Regional Assessment), while other decision support systems may be formalized to serve a particular temporary policy purpose (e.g. advisory councils appointed in support of state or national policy decisions).

Given the need for relevant and applicable information, decision support approaches are most effective when tailored to specific decision-making environments (National Research Council 2009). To date, limited research has examined the decision-making environment of fire managers in the lake states. In one recent study, interviews were conducted with managers from The Nature Conservancy, Michigan Department of Natural Resources, and two federal agencies-the US Forest Service and the US Fish and

Wildlife Service (Wilson et al. 2009). This study found that the reduction of fuel loads to prevent future catastrophic fire was a primary fire management objective across the region. Forest management decisions were often focused on achieving environmental objectives, with the three most cited objectives being to promote wildlife diversity, promote habitat diversity, and coordinate management efforts across landscapes. Results also indicated managers exhibited a strong desire to use more prescribed fire in their management programs (62% selected this as their most desired management change) but were limited from doing so by mandates and statutes, lack of ecosystem knowledge, lack of resources, public perceptions, and wildland-urban interface constraints. In addition, most managers also stated they were concerned about risks posed by fire to human life, timber products, and other property, suggesting that risk aversion may also be a factor in the decision to suppress a wildfire or postpone a prescribed burn. Overall, although managers recognized the importance of fire in mixed-pine forest ecosystems, they found it difficult to implement in practice (Wilson et al. 2009).

Management Context.

Although in the United States, wildland fires are generally viewed as an issue with regional importance to the western or southern states, there have been several significant fires in Michigan, Wisconsin, and Minnesota in recent years. In 2005, Wisconsin's Cottonville Fire became the state's largest blaze in over 25 years, burning over 3,400 acres. Minnesota's 2006 Cavity Lake Fire consumed 32,000 acres, while the 2007 Ham Lake Fire destroyed 60 homes. Most recently, Michigan's 2010 Meridian Boundary Fire forced the evacuation of numerous homeowners and consumed over 8,500

acres of dense jack-pine forest. As of August 2010, the three states had experienced a combined 3,549 wildfires that had consumed over 46,200 acres year-to-date (National Interagency Fire Center 2010). In addition, the region has experienced several high-profile incidents involving escaped prescribed burns, including Michigan's Mack Lake Fire in 1980 that escaped control lines and burned 20,000 acres, resulting in one firefighter fatality and the destruction of 44 homes and buildings.

Several region-specific factors contribute to the wildfire risk. Public lands in the northern lake states are frequently characterized by a highly fragmented ownership pattern where small publicly-owned parcels are mixed with private property and rural neighborhoods. Human populations are dense, with nearly all forests in the region located within 25km of densely populated communities (Radeloff et al. 2005). In addition, most fires in the region are of human origin. Debris-burning, a practice commonly used to dispose of trash and debris from land clearing, is the cause of most fire starts across the region. Arson is also a primary concern; more than half of all fires over 40 ha in size are deliberately set (Cardille and Ventura 2001). Finally, fire management plans must incorporate the habitat requirements of the federally protected Kirtland's Warbler (listed as endangered under the Endangered Species Act), a ground-nesting, Neotropical migrant that breeds in the fire-dependent jack-pine ecosystems of the Upper Midwest (Corace et al. 2010, Probst and Weinrich 1993).

While forest restoration and fuel management programs that utilize prescribed fire have long been in place throughout much of the western U.S., these programs are relatively new to the northern lake states region. Following a series of federal initiatives that emerged in 2000 and subsequent years (e.g., the National Fire Plan, Ten Year

Comprehensive Strategy, Healthy Forests Restoration Act), federal agencies within the lake states began to build their fire management programs. While programs have grown in recent years, the wildland fire management and research infrastructure in the lake states are in early stages of development compared to similar programs in the more fire-prone areas of the country.

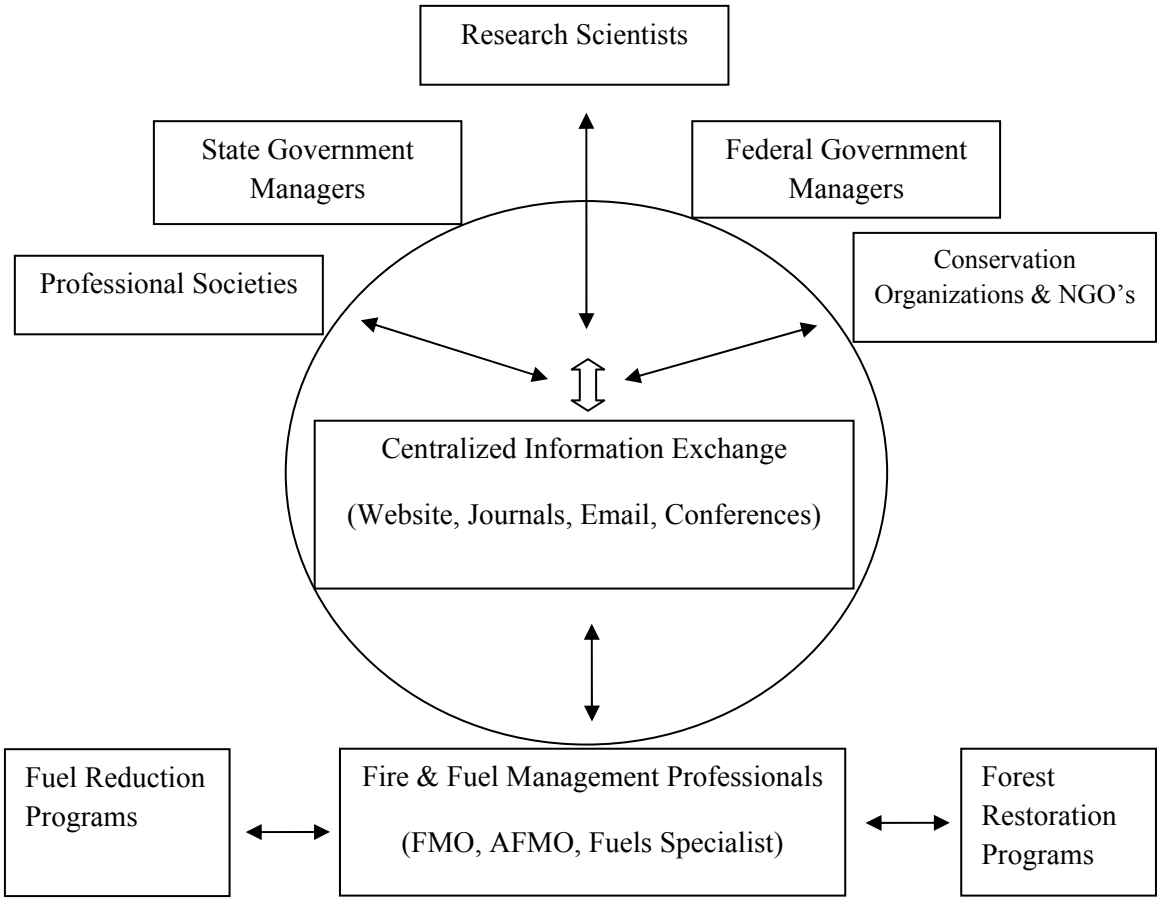

Figure 3.1. Fire and Fuel Management Decision Support Framework

Given the relatively short history of fire and fuel management programs within the region, limited research has been completed to date to examine the context of these programs as well as the decision-making environment of managers as they strive to implement, manage, and refine programs that accomplish multiple objectives. The long-term goal of this line of inquiry is to develop a comprehensive decision-support network of fire professionals and researchers, allowing decision-makers across the region to access and apply the latest information applicable to their unique situation, rather than relying solely on past experience or status quo tactics. *Figure 3.1* provides a conceptualization of the decision support framework and the flow of information within the context of fire and fuel management.

RESEARCH DESIGN

The present research was conducted in two phases. First, semi-structured, telephone interviews were conducted with 12 managers from Michigan and Minnesota. Participants were employees of the US Forest Service, US Fish and Wildlife Service, National Park Service, Bureau of Indian Affairs, The Nature Conservancy, as well as state natural resource departments. Interview questions included a series of open-ended questions designed to elicit a broad range of individual responses on topics such as fuel reduction and forest restoration methods, factors affecting method implementation, factors that influence management decisions, and preferred sources and methods for communicating emerging fire science information.

In the second phase, an Internet survey was developed based on prior research as well as findings from the phone interviews that allowed us to target questions to local

management strategies and concerns. Survey items included closed-choice questions that again addressed the issues of fuel reduction and forest restoration methods, factors affecting method implementation, factors that influence management decisions, and preferred sources and methods for communicating emerging fire science information. Survey questions allowed respondents to write open-ended responses in addition to selecting among the closed-choice options.

The web-based survey targeted managers from across the northern lake states region (MI, WI, MN) who were employed by state, federal, tribal, and non-governmental natural resource management organizations that were actively utilizing fire as a land management tool. Potential participant lists were obtained from agency contacts across the region. In addition, participants who completed the survey were asked to provide contact information for colleagues that should be included in the sample.

Survey implementation followed a modified version of the 'total design method' (Dillman 1978), using a series of emails to encourage participation. An introductory email was sent to potential participants in mid-December, 2009 explaining the objectives of the project and notifying them that they would soon receive an invitation to complete an Internet survey. Shortly thereafter, the first invitation was sent via email inviting participants to take the survey. Two additional e-mail invitations were sent to non-respondents in January and February, 2010 encouraging survey participation. Of the 120 people contacted, 81 returned completed surveys, resulting in a 68% response rate. A response at this level is regarded as sufficient for a descriptive study of this nature (Lehman 1989, Needham and Vaske 2008).

Qualitative analysis of interview data was conducted by organizing responses by thematic area to determine the frequency of responses. Quantitative analysis of survey responses included multiple steps. The data was first summarized using descriptive statistics. Findings were then compared across study locations using chi-square tests to determine notable differences among states. Findings enable comparisons to be made across the region and allow for the discussion of several strategies to guide the direction of future research and improve the communication of scientific information throughout the northern lake states region.

FINDINGS

The following sections describe findings from both the qualitative and quantitative portions of this research. Displayed percentages and statistical tests are conducted on survey responses. When appropriate, interview themes and quotes are described to provide additional details and explanation of survey results.

Summary of study participants.

Study participants were employed as fire managers (41%), forest managers (19%), wildlife biologists (12%), researchers (7%), and in other natural resource management occupations (21%) including wildlife refuge manager, fuels specialist, and conservation director. Respondents represented the states of Michigan (40%), Minnesota (41%), and Wisconsin (19%), respectively, and were drawn from a variety of employers including state and federal government agencies, non-profit land management

	MI	MN	WI	Total
Results by Title				
Fire Manager	12	14	7	33
Forest Manager	9	4	2	15
Wildlife Biologist	3	5	2	10
Researcher/Scientist	1	3	2	6
Other	7	7	3	17
Results by Agency				
State DNR	14	10	9	33
USFS	8	9	2	19
USFWS	6	4	1	11
NPS	2	1	1	4
BIA	0	4	0	4
Private/Non-governmental (e.g. TNC)	2	5	3	10
Total Respondents	32	33	16	81
Results represent number of respondents.				

Table 3.1. Summary of web-based survey respondents

organizations, tribal organizations, and the forest products industry. *Table 3.1* provides a complete breakdown of survey respondents by state, title, and employer.

Forest restoration and fuel reduction methods.

Respondents were asked to indicate the frequency with which they utilized various methods to achieve forest restoration and/or fuel reduction objectives (*Table 3.2*). In aggregate, managers throughout the lake states region were most likely to use mechanized thinning and prescribed fire, while herbicides and wildland fire use (actively managing a wildfire to accomplish land management objectives instead of engaging in immediate suppression) were much less prevalent.

Statement	MI	MN	WI	Average	Chi-square
How often are the following methods utilized to achieve your forest restoration and/or fuel reduction objectives…					
Mechanized thinning					0.773
Often/Always	66%	67%	56%	64%	
Never/Rarely	13%	12%	13%	12%	
Prescribed fire**					0.012
Often/Always	22	58	75	47	
Never/Rarely	19	12	13	15	
Mowing					0.415
Often/Always	25	21	50	28	
Never/Rarely	34	46	25	37	
Herbicide**					0.016
Often/Always	9	12	44	17	
Never/Rarely	59	52	25	49	
Wildland fire use					0.876
Often/Always	3	3	0	2	
Never/Rarely	78	82	81	80	

** Responses are significantly different between locations at $p \leq .05$.
"Sometimes" responses are omitted for presentation purposes.

Table 3.2. Utilization of methods to achieve objectives, state by state comparison

Geographic variation. Significant geographical variation was found between states regarding the frequency with which the various methods were used. For example, managers in Michigan were significantly less likely to use prescribed fire than their colleagues in Minnesota and Wisconsin. Less than one in four Michigan managers (22%) reported using prescribed fire often or always, compared to more than one half of managers in Minnesota (58%) and three out of four in Wisconsin (75%). Interview responses from Michigan managers provide evidence that this may be due in part to past incidents with prescribed fire in the state and a lack of public support for the practice.

According to one manager "There is a history of large escaped fires in the area, people don't forget those. The Mack Lake fire still impacts public opinion."

Notable differences were also observed between states regarding herbicide use. Managers in Wisconsin were significantly more likely to use herbicide treatments than their colleagues in Michigan and Minnesota, with almost one half of Wisconsin managers (44%) reporting that they used the practice often or always, compared to 12% in Minnesota and just 9% in Michigan. Certain practices were used rarely throughout the region; for example, few managers made use of wildland fire use in any of the three states.

Objectives of treatment use.

While the frequency of treatment use is helpful in determining how often various methods are utilized in fire and fuel management programs throughout the region, it is also important to understand the underlying objectives managers seek to achieve through treatment implementation. *Table 3.3* provides an analysis of five treatment methods and the primary objectives for which they are used by managers throughout the lake states. When asked if a treatment was used primarily to restore forest conditions, reduce forest fuels, or a combination of both, more than half of all managers in aggregate reported that prescribed fire (78%) and mechanized thinning (57%) were used primarily to accomplish both. Herbicides (43%) and mowing (27%) were cited most often as being used primarily to restore forest conditions. Interestingly, reducing forest fuels was not the primary objective for any of the five methods discussed, suggesting that fuel reduction may be a secondary priority throughout the region.

Statement	MI	MN	WI	Average	Chi-square
Does your management area utilize these methods primarily to restore forest conditions, reduce forest fuels, or both…					
Mechanized thinning					0.282
Restore forest conditions	25%	30%	25%	27%	
Both	63%	46%	69%	57%	
Reduce forest fuels	6%	21%	0%	11%	
Don't use the practice	6%	3%	6%	5%	
Prescribed fire					0.063
Restore forest conditions	6	12	38	15	
Both	81	82	63	78	
Reduce forest fuels	6	6	0	5	
Don't use the practice	6	0	0	3	
Mowing					0.65
Restore forest conditions	25	24	38	27	
Both	28	21	25	25	
Reduce forest fuels	22	24	31	25	
Don't use the practice	25	30	6	24	
Herbicide					0.44
Restore forest conditions	44	39	50	43	
Both	22	12	25	19	
Reduce forest fuels	9	3	6	6	
Don't use the practice	25	46	19	32	
Wildland fire use					0.926
Restore forest conditions	13	9	13	11	
Both	22	27	25	25	
Reduce forest fuels	3	0	0	1	
Don't use the practice	63	64	63	63	

Table 3.3. Objectives associated with treatment methods, state by state comparison

Geographic variation. Again, key differences emerged between states when we examined the primary objectives associated with treatment implementation. While prescribed fire was used by a majority of managers in all three states to accomplish a combination of fuel reduction and forest restoration objectives, the number who reported

using prescribed fire primarily to restore forest conditions was far greater in Wisconsin (38%) than in Minnesota (12%) or Michigan (6%). In addition, managers in Minnesota (21%) were much more likely than their colleagues in Michigan (6%) and Wisconsin (0%) to use mechanized thinning primarily as a means to reduce forest fuels. These differences highlight the unique approaches that are utilized across the region.

To get a sense of constraints influencing management, participants were asked to indicate if they would prefer to use any of these treatments more than their current levels. Nearly all respondents, 95%, agree that they would like to use prescribed fire more often while majorities would also like to increase their use of wildland fire use (64%) and mechanized thinning (52%). On two treatments, mowing and herbicide, a majority of managers indicated they were content with their current levels of use. Regarding increased use of fire throughout the region, several participants noted the challenge at doing so due to interface constraints and resulting agency liability. As one manager stated, "When you choose to manage a fire for fire use, you open up a huge amount of liability and responsibility to the agency".

Influencing factors.

Given the varying frequencies and differing objectives for treatment use, we were interested in the factors that influence forest restoration and fuel management decisions throughout the northern lake states. Natural resource management decisions are complex and rarely consist of a single set of circumstances or a sole group of interested stakeholders. Rather, managers must operate in a complex environment in which decisions are made depending upon the interactions of available resources, legal

obligations, agency mandates, public pressures, and other factors. Seeking to develop a more thorough understanding of this environment, we asked managers to rate the degree to which certain factors influenced their forest restoration or fuel management decisions.

Survey participants were asked to evaluate 12 closed-choice response options for their level of influence on management decisions (*Table 3.4*). Possible response options were developed from prior literature as well as interview findings from phase 1 of this research. Results demonstrate that, indeed, there are a variety of factors that play a large role in influencing agency managers. Across all states and all agencies, budget constraints were the primary variable reported by managers as having a great deal of influence on management decisions.

Statement	Not at all	Slightly	Moderately	A great deal
How much do the following factors influence your forest restoration and/or fuel management decisions…				
Budget constraints	0%	7%	35%	58%
Competing agency interests	3	26	44	27
Interface constraints	4	30	40	27
Agency mandates	9	38	35	19
Previous agency actions	12	35	37	16
Your forest plan	14	35	37	15
Laws	5	48	33	14
Habitat requirements	9	31	47	14
Pressure from public stakeholders	6	44	41	9
Past personal experiences	21	43	27	9
The scientific community	28	48	17	6
Professional societies	56	37	6	1

Table 3.4. Factors influencing forest restoration and fuel management decisions

More than one in four managers (27%) indicated that they were greatly influenced by competing agency interests, often described as the differing objectives held by individual management sectors such as wildlife, recreation, timber, engineering, etc. In addition, another quarter of participants reported a great deal of influence from interface constraints (27%), defined as the limitations presented by managing lands in close proximity to human development and/or private lands. Within the northern lake states region, the proximity of public lands to highly developed areas and complex public-private ownership patterns are important factors that exacerbate the effect that interface constraints can have on management implementation.

In contrast, responses also indicated the limited influence of professional societies and the scientific community. Given the fact that the overall wildland fire management and research infrastructure is less developed in the lake states than in other regions of the country, this finding may be attributable to the relatively short time-frame in which these types of relationships have been allowed to develop. However, these responses suggest ample opportunities for these two entities to expand their role in interacting with managers on the ground and influencing agency management decisions.

Interview findings provide additional insight into these responses. Regarding the influence of budget constraints, one interviewee stated the following, "Land managers are frustrated by not being able to accomplish the treatments they propose. Funding is a major barrier to treatment implementation and I believe our agency's prescribed fire program will decrease in years to come." Competing agency interests were also commonly mentioned as an influencing factor in treatment utilization, with one

interviewee saying, “We would love to use more prescribed fire, but competitive interests like recreation, timber and wildlife often prevent that.”

Although often citing the difficulty of implementing fire and fuel management treatments within the context of shrinking budgets and a multiple use management structure, participants also displayed an inventive, team-oriented approach to solving problems. One respondent stated, “Budgets are limiting, but if we work with wildlife, timber, etc. we can pool money to stretch our dollars. But, this requires trust, communication, and a little give and take among everyone involved.” Another interviewee said, “Competing interests often complicate my plans. But, we must take a team approach.” These quotes demonstrate not only the impact of certain influencing variables on management decisions, but also the willingness of managers throughout the region to embrace challenges in an effort to find collaborative solutions.

Geographic variation. Although no significant differences existed across locations, several notable variances were observed. For example, when asked about competing agency interests (e.g. recreation, timber, wildlife, etc.) managers from Wisconsin (50%) were much more likely than their colleagues in Michigan (22%) or Minnesota (21%) to report the factor as having a great deal of influence on their management decisions. Managers from Minnesota appear to be less influenced by legal requirements, with 12% of Minnesota managers reporting that laws have no influence on their decisions, compared to managers in Michigan (0%) and Wisconsin (0%). Similarly, 25% of Wisconsin managers reported their forest plan as having no influence on their management decisions, compared to their colleagues in Minnesota (12%) and Michigan

(9%), suggesting that forest plans are perhaps less utilized as a decision-making tool in Wisconsin.

Sources of fire-science information.

The process by which emerging fire science information is generated, communicated, and incorporated into management applications is incredibly complex, involving a number of processes that must be completed to successfully disseminate new information from the laboratory to the practitioners in the field. Information is generated regularly by the scientific community; however, the generation of information and the dissemination of information to the intended target audience (e.g. fire managers) are two very separate processes. In order to communicate emerging fire science information in the most effective manner, we sought to better understand how managers currently use and receive fire science information, the most effective format(s) for communicating new information, and the common barriers that inhibit successful communication between the scientific and the management communities.

We began by asking managers to describe how often they use various sources to acquire information on fire management and forest restoration (*Table 3.5)*. Findings show that, overwhelmingly, management colleagues are utilized most often to acquire fire management information. In aggregate, more than three out of four respondents (80%) said that they used colleagues either often or always as a source of information. In decreasing order, this was followed by agency research scientists (40%), academic research scientists (24%), and professional societies (14%).

Statement	MI	MN	WI	Average	Chi-Square
How often do you use the following sources to get information on fire management and forest restoration…					
Management colleague					0.052
Often/Always	81%	79%	81%	80%	
Never/Rarely	3%	3%	0%	2%	
Agency research scientist					0.464
Often/Always	34	39	50	40	
Never/Rarely	22	36	13	26	
Academic research scientist					0.889
Often/Always	19	27	25	24	
Never/Rarely	28	27	31	29	
Professional society					0.643
Often/Always	19	9	13	14	
Never/Rarely	53	73	63	63	

"Sometimes" responses are omitted for presentation purposes.

Table 3.5. Sources of fire management information, state by state comparison

We further explored this issue by asking respondents to indicate the two sources from which they *most* preferred to receive information. Again, management colleagues (86%) and agency research scientists (70%) were the most preferred sources, while academic research scientists (27%) and professional societies (12%), were less preferred among all respondents.

When asked to articulate the various reasons why certain sources are preferred over others, survey respondents were quick to point out the important elements of trust, personal connection, and practical "on the ground" experience as reasons why they prefer to receive information directly from management colleagues. When asked to explain who they preferred to receive fire science information from, one manager wrote "Personal operational experience is perhaps the best source of unbiased info...not cluttered with

required documentation or reference citings. The profession of fire applications is best informed by professional people who actually implement projects. Not to be insulting, but unless someone knows what it takes to implement on the ground projects, it's very difficult to prescribe activities." In similar fashion, another manager wrote "I prefer to receive my information from people that have worked on a fireline, not people that have gained all their experience with fire from the academic world. People that talk about fire, but have never worked on a fire scare the hell out of me!"

Yet another respondent focused on the technical time and personnel components that are critical to successful fire operations, stating "I prefer to get information from other management colleagues because they have usually ground-truthed it, and most importantly they know the time and personnel requirements". Similarly, another respondent said, "They (management colleagues) are in touch with what is happening on the ground, and best understand real world management." Finally, one manager summarized their reasons for preferring to receive information from management colleagues by writing simply three words, "Trust, experience, availability", while another summarized it by saying "Essentially, it is a trust factor." These findings highlight the critical role of trust in information exchange and make it clear that management colleagues carry a great deal of credibility within the world of professional fire management.

Formats for communicating fire-science information.

Communication consists of both the content to be communicated and the method used to exchange information. Both components play an important role in the effective exchange of information. Therefore, we asked managers to rate the usefulness of eleven commonly used methods for communicating fire science information (*Table 3.6*). In these ratings, one method, trips to field/demonstration sites stood apart from the others as it was rated as very or extremely useful by a large majority of participants (81%). This was followed by conferences/professional meetings (59%) and condensed research summaries (53%) that were rated very/extremely useful by just over a majority of participants. Approximately one-third of participants gave the next three methods similar ratings – General Technical Reports (38%), internet websites maintained by research organizations (33%), and newsletters from research organizations (31%).

Statement	Not at all/ Slightly	Moderately	Very/ Extremely	Chi-Square
How useful is each of the following methods to exchanging information…				
Trips to field/demonstration sites	3%	16%	81%	0.793
Conferences/professional meetings	9	31	59	0.526
Condensed research summaries	13	33	53	0.726
General Technical Reports	25	37	38	0.623
Internet websites by research organizations	24	42	33	0.406
Newsletters from research organizations	26	43	31	0.963
Internet websites by professional societies	35	37	22	0.055
Email listserves	40	38	19	0.734
Newsletters from professional societies	47	35	17	0.256
Virtual meetings	37	48	11	0.661
Telephone conference	48	42	9	0.052
"No Opinion" responses are omitted for presentation purposes.				

Table 3.6. Usefulness of methods to exchanging fire science information

Few participants found the final methods to be very useful. It is notable that these methods included several technologically based methods.

Barriers to fire-science information exchange.

Regarding barriers to information exchange, respondents overwhelmingly agreed that time was the greatest obstacle they faced in obtaining the best information to inform their management decisions (*Table 3.7)*. In aggregate, 68% of managers, including a majority in each state (82% in MN, 63% in WI, 56% in MI) agreed that they did not have

Statement	MI	MN	WI	Average	Chi-square
Indicate your level of agreement regarding the following challenges to receiving the best fire science information available…					
Don't have time to look for information**					0.013
Agree	56%	82%	63%	68%	
Disagree	9%	18%	13%	14%	
Information is not easily accessible					0.795
Agree	47	36	44	42	
Disagree	22	25	25	24	
Information is not applicable to me					0.603
Agree	25	42	38	35	
Disagree	31	27	31	30	
Don't know where to look for information					0.447
Agree	38	27	31	32	
Disagree	38	46	25	38	
Concerns about information credibility					0.415
Agree	16	18	13	16	
Disagree	53	30	31	40	

** Responses are significantly different between locations at $p \leq .05$.
"Neither disagree nor agree" responses are omitted for presentation purposes.

Table 3.7. Barriers to information exchange, state by state comparison

enough time to look for information. Further, more than one in three agreed that information was not easily accessible (42%) or not applicable to them (35%). On a positive note, information credibility was not a major concern, with only 16% of respondents agreeing that they have concerns about the credibility of the information that is available.

Respondents were given the opportunity to elaborate on their responses via open-ended comment boxes. When asked about barriers to obtaining current information, one manager wrote, "Time is the big one (barrier), for all aspects of the job. There is a need for quick access to bite size nuggets of applicable information with links to more information of especially appropriate material".

Although it may seem logical to assume that more information is always better, the large amount of information available was often cited as something that makes it difficult for managers to locate findings that are applicable to their specific management context. For instance, one manager wrote, "There is sometime(s) too much information out there." Yet another stated, "The volume of available information is overwhelming, having information broken down by geographic area is helpful." A third manager reported, "Given the diversity of forest conditions within the northern great lakes, the applicability of information that is specific enough to the local situation is the biggest challenge."

Highlighting the importance of the method selected to communicate information, one manager summarized the situation by stating, "Publications from academic researchers are often not in a format easily accessible to resource practitioners. Peer-reviewed journals are important, but other venues of sharing research results must be

emphasized. These could include workshops, field demonstrations, conferences oriented towards land managers, and short research summaries shared via email or the Internet."

Finally, we asked managers if they had the opportunity to help shape the information that is generated through ongoing and future research. Results indicate that, as a whole, managers do not feel involved in shaping research projects within the region. A majority (54%) selected "no" or "unsure" (among possible response options of yes, no, and unsure) when asked if they currently had the means to help shape the information that is generated through research. However, respondents believed strongly that they should be more involved in this process, with one manager stating "There needs to be some way for managers to engage. There's lots of good ideas that just never get heard by the research community." When asked to further elaborate on specific ways in which the management community could be involved in shaping research, many ideas were presented. One respondent said that managers should "Indicate what research is needed for direct management application and not just research for the sake of looking at something generally interesting. General research is useful for the overall knowledge base, but front line managers need information in a manner that can be immediately applied." Similarly, another manager stated that "Too often I hear of research going on that is interesting, but has no practical applications. The most meaningful and useful research is that which is driven at the request of managers to solve real problems experienced on the ground."

Several participants highlighted the importance of developing an iterative, proactive channel for ongoing communication between managers and researchers through the entire cycle of the research process. In particular, managers were interested in being

involved in the initial stages by contributing to research questions rather than the currently common practice of viewing them simply as consumers of information resulting from research conducted with little or no engagement of managers. Respondents often stated their on the ground experience afforded them a unique perspective as to the important issues requiring further research, with one interviewee saying “Managers are frequently the first to see issues and hear what the public and stakeholders are saying (both positive and negative) in regards to fire and fuels management”. Another respondent stated, “They (managers) should be active in the development of the research questions being addressed on the front end in the development of research projects. Rather than once the research is done attempting to form fit the research to our questions.” Still another said, “They (managers) should be identifying most of the priorities or at least highlighting the practical questions to help set research priorities.” Finally, one respondent suggested a more systematic approach to facilitating collaboration between the management and research communities. “At least in the Forest Service regional office where I work, there should be an annual mechanism (regionally) to identify prioritized research needs and funding sources. Currently it appears to me that researchers go to whomever will give them money but the research is not necessarily focused on regional priorities (because there don't seem to be any)”. Perhaps one of the most important elements in cultivating a more productive relationship is communication, summarized nicely by one interviewee when asked how managers could be involved in the research process. “Be in communication with your researchers! We (managers) cannot influence the research if we don't build these relationships”.

Finally, and perhaps most encouraging, 90% of managers surveyed indicated that they would like to be involved in the development and operation of a comprehensive decision support system within the northern lake states region. This is an encouraging finding as it indicates that managers not only see the need for such a system, but also that they are willing to be active in fulfilling the intent of the system to promote information exchange and allow for the integration of emerging fire science information into management decisions.

DISCUSSION

This study was designed to explore the decision-making context of fire managers in the northern lake states. Findings provide important information regarding the ongoing management activities within the region and preferences for the development of a comprehensive decision-support network for fire management personnel. Several important points are noteworthy.

First, it is evident that managers utilize methods at varying rates of frequency and seek different objectives from their management programs across the region. Although it may be convenient to think of the northern lake states region as a geographical unit upon which common standards could be applied, results here suggest vastly different fire and fuel management programs are in place. This should not be surprising given the large number of varying forest ecosystem types and the number of managing agencies across these three states. This variability lends further credence to the need for a decision-

support system that can develop localized information for specific needs, rather than broad recommendations that are only moderately applicable to each unique situation.

Consistent with prior research in the region (Wilson et al. 2009), the majority of managers in aggregate indicated a strong desire to use more prescribed fire and wildland fire use to accomplish management objectives. This is an encouraging finding as it suggests that managers recognize the role of fire in restoring healthy forest ecosystems. However, several region-specific factors place limitations on managers' ability to use fire across the landscape. Results also provide further evidence of the importance of using fire carefully, as it appears that Michigan managers are still trying to overcome past mishaps (Mack Lake Fire) with prescribed fire. Lastly, although Wilson et al. (2009) found that 62% of managers believed reducing fuel loads was a primary concern throughout the region, results here suggest that the reduction of forest fuels is rarely the primary objective of forest managers across the region. Instead, it appears that fuel reduction is often accomplished in conjunction with or as a secondary benefit of the restoration of forest conditions.

Second, managers develop, implement, and refine management programs within the framework of numerous, sometimes counteracting variables that influence their decisions. Across all agencies and all locations, the lack of financial resources to implement treatments was reported as having the greatest influence on management decisions. Budget constraints have often been an important consideration in natural resource management, although not necessarily one that applies only to management agencies in the lake states. Creative solutions will need to become more commonplace if treatment programs are to continue in the midst of shrinking resources. During the

interviews, several managers exhibited willingness to pool financial resources and overcome increasing budget limitations. Given the relative lack of expansive public lands with the region, such efforts will be important not only to overcome limited resources but also to achieve many of the ecological objectives of managers.

One troubling finding from this research was the degree to which competing agency interests were discussed as a limiting factor in forest restoration and fuel management decisions. The multiple use objectives for which much of the land in the northern lake states is managed demands that fire and fuel management programs take into consideration many factors other than strictly forest restoration and/or fuel load reduction. However, managers here expressed a good deal of frustration with their ability to work together with their wildlife, recreation, and timber colleagues to effectively manage lands to achieve larger, overarching goals.

The take away message regarding influencing variables is that fire and fuel management in the northern lake states does not occur in a vacuum where managers simply receive and apply the latest scientific information to accomplish their preferred objectives. Indeed, many interview participants indicated that, for many of the reasons discussed here, they rarely have the luxury of using their preferred method or using it as often as they would like. Instead, decisions must take into account a multitude of factors (both internal and external) and weigh the costs and benefits of varying options until an approach is determined that is agreeable to all stakeholders involved. Managers expressed frustration that this approach rarely yields their most preferred fire and fuel management methods on the ground. However, with regard to stakeholder involvement, prior research does suggest that treatment acceptance is influenced by the amount of citizen

involvement in developing the treatment plans (e.g., Winter et al. 2002, Blanchard and Ryan 2007). These findings, combined with the multiple-use objectives throughout the northern lake states, suggest that although this increases the management complexity, incorporating multiple management disciplines is necessary to achieve the long-term goals of managing agencies.

Finally, findings here provide a great deal of insight into the current processes of information exchange and decision support within the region. First, it is apparent that managers throughout the region rely heavily on management colleagues and agency research scientists to acquire information on fire management and forest restoration issues. These two groups were the most often used and the most preferred sources of information. This appears to be due largely to the fact that managers believe these two groups have greater "on the ground" experience and they therefore place a greater degree of trust in these individuals and the information they provide.

One surprising finding from this research is the limited degree to which professional societies and the scientific community are used to acquire fire science information throughout the region. These two entities were the least often used and the least preferred sources of information among all respondents and have limited influence on management decisions among all the options provided. While this may be alarming to these communities, it should be noted that the relatively young nature of many fire and fuel management programs throughout the region suggests that the relationships between managers and these two entities may not yet be fully developed. In addition, this finding suggests there is a great deal of opportunity for additional involvement from professional societies and the research community and provides further justification for the

establishment of a decision support system that brings together information producers and information users to promote increased information exchange.

Also, it is apparent that the method of communication influences the effectiveness of communication activities. Interactive methods, such as trips to field/demonstration sites and conferences/professional meetings were appreciated by a majority of participants. Consistent with responses regarding the limited time managers had to research available information, condensed research summaries were also highly rated by managers. These findings suggest that while some mass communication methods may be necessary to build awareness of emerging information, managers are looking for methods that provide a means to tailor emerging information to their specific decision-making environments (National Research Council 2009). Similar findings have been identified regarding agency communication methods with the public in fire affected communities and are consistent with findings from adult learning (Toman et al. 2004).

Time and accessibility were rated as the greatest barriers to information exchange, further justifying the need for the production of decision-relevant information that is condensed and easily accessible. Interestingly, field trips and conferences are generally time consuming activities. Thus, while such methods were highly rated, it is likely that additional communication methods, with lower time requirements, will also play an important role in a comprehensive decision-support program. It is also important to note that despite the expressed challenges to receiving information, managers were not concerned with the credibility of the research community in the region.

CONCLUSIONS

This study was designed to begin to examine the decision-making context of fire managers in the northern lake states region (MI, WI, MN) to understand 1) methods currently used to achieve forest restoration and/or fuel reduction objectives, 2) factors that influence decisions regarding the adoption of these different methods, and 3) availability of information exchange and decision support. It is clear that important differences exist across the region, numerous factors influence management decisions, and that managers use various approaches to accomplish their objectives.

To be successful, a region-specific decision support system will need to take these differences into consideration. In addition, professional societies and academic research scientists would do well to focus on building trust and credibility with managers while considering the preferred methods and formats for communicating fire science information reported in this study. It is clear that managers desire a greater degree of involvement in the research process and believe that they have a lot to offer in terms of informing the direction of future research. Given the important role of management colleagues in exchanging information, a decision support system would benefit greatly from the presence of a vocal manager to spearhead the operation and disseminate emerging information to the field. Finally, the overwhelming support and recognition for such a system by area managers reported in this study suggests that a decision support system in the northern lake states would have the stakeholder support needed to succeed.

Chapter 4: Conclusion

Across the U.S., wildland fire is impacting a growing number of citizens. Human populations within the Wildland Urban Interface (WUI), average fire size, and the annual number of acres burned have all increased dramatically in recent years. As this paper was being finalized in August, 2010, the Fourmile Canyon Fire became the most destructive wildfire in Colorado state history, destroying 169 structures and resulting in the evacuation of thousands of forest residents in the WUI foothills west of Boulder, Colorado. The devastation provides a timely example of the high stakes that are present in the increasingly complex interactions between people, fires, and forests. In response to this growing threat, a series of federal initiatives have been implemented including the National Fire Plan, Ten Year Comprehensive Strategy, and the Healthy Forests Restoration Act. 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. Second, these policies encourage, and in some cases require, local partnerships to identify and accomplish fuel management objectives.

As managers strive to operate within the framework established by these initiatives, multiple factors will influence their ability to achieve their desired objectives. Two issues of particular importance to successful restoration of forest conditions and reduction of fire risk include 1) improved understanding of the factors that influence

public acceptance of management practices (e.g. prescribed fire, thinning, mechanical vegetation removal) used to treat forest fuels, and 2) development and communication of relevant scientific information to support comprehensive fuel management programs that are appropriate for the ecological, social, and political characteristics of a particular region.

This study was designed to evaluate the public acceptance of fuel management programs by examining public responses over time and across geographic locations while also exploring the decision-making environment of fire managers in a subset of locations as they build fire management programs. This project was centered around the following research objectives:

1. To identify and analyze citizen support for fuel management practices (particularly prescribed fire and mechanical vegetation removal) over time (2002-2008) and across locations (AZ, CO, OR, UT, MI, MN, WI).
2. To examine the factors (e.g., awareness, trust, citizen-agency interactions) that influence public acceptability of fuel management programs.
3. To explore the decision-making environment of fire managers and examine the factors that influence their decisions (e.g., availability of information and tools, institutional constraints, perceived attitudes of public stakeholders).

Findings reflect the perspectives of citizens who live adjacent to public forestlands and the fire managers who strive to keep them safe–both critical stakeholders in the context of wildland fire management. Results suggest that most citizens recognized the need for fuel treatments and were willing to support some level of use on public lands in both 2002 and 2008. Important differences emerged across locations regarding citizen

support for fuel management practices, highlighting the importance of tailoring programs to address the specific characteristics that are present at the local level.

Regional location, trust in agency managers to effectively implement treatments, and belief that treatments would result in various positive outcomes were all shown to significantly predict acceptance levels of fuel treatment programs. Thus, we believe that managers should focus first on building a strong foundation of trust with local citizens that can support and promote future positive interactions. Forest agencies are advised to engage public stakeholders in a manner that allows for the simultaneous building of trust and communication of the positive outcomes that can result from proper treatment utilization. Interactive communication approaches, such as trips to demonstration sites and forest tours, may provide the appropriate venue for these types of interactions.

Finally, it is clear that numerous factors influence the decisions made by fire managers in the northern lake states, with budget constraints, competing agency interests, and interface constraints having the greatest degree of influence. Regional variation was observed in terms of how often treatments were used and the objectives sought by treatment implementation; however, managers across the region expressed a strong desire to be involved in a network of professionals designed to promote the exchange of emerging fire science information.

Overall, this project provides a great deal of insight into citizen perspectives on fire and fuel management practices as well as the various factors that influence management decisions and the manner in which information is exchanged within the fire management community. Findings can be helpful to forest agencies as they continue to

strive to build public support for their fuel treatment programs and create programs that take advantage of the best available scientific information.

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Appendix A: Frequency Report of Longitudinal Analysis Responses

Table values are percents unless otherwise noted. P-values reflect paired t-test scores (with "don't know" or "no opinion" responses excluded) unless noted.

1. How far is it from your home to a natural area where a wildfire might burn (average miles)?

	2002	2008	P-value
Total	3.4	3.5	0.822
AZ	3.6	3.7	0.966
CO	2.6	3.9	0.048
OR	1.2	2.5	0.029
UT	4.9	5.7	0.365
MI	4.2	4.7	0.685
MN	4.3	2.3	0.136
WI	2.4	2.4	0.955

Table A.1. Distance from home to area where wildfire might burn

2. How would you rate the likelihood that a wildfire could occur in the forests or rangelands near your home in the next five years?

	Very likely		Somewhat likely		Somewhat unlikely		Very unlikely		Don't know		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	31	25	36	38	19	22	9	11	4	5	0.008
AZ	40	35	37	45	17	10	5	10	2	0	0.666
CO	41	47	38	33	10	13	9	3	2	4	0.404
OR	56	50	35	37	4	6	4	6	0	1	0.435
UT	54	37	27	49	9	9	6	4	4	1	0.242
MI	21	10	35	40	26	31	13	13	5	6	0.202
MN	15	5	39	30	28	39	11	16	7	10	0.011
WI	9	10	42	36	28	33	13	17	8	5	0.219

Table A.2. Likelihood of wildfire occurring near home in next five years

3. In my opinion, using *prescribed fires* on public forests and rangelands is:

	A legitimate tool that resource managers should be able to use whenever they see fit.		Something that should be done infrequently, only in carefully selected areas.		A practice that should not be considered because it creates too many negative impacts.		An unnecessary practice.		I know too little to make a judgment about this topic.		P-value (X^2 test)
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	45	44	45	41	3	5	2	2	5	9	<.001
AZ	50	61	47	25	0	7	2	0	2	7	<.001
CO	52	34	42	56	3	3	1	1	1	6	0.194
OR	55	60	37	30	7	7	1	0	0	3	<.001
UT	40	41	52	50	3	3	0	0	6	6	0.001
MI	35	31	38	42	9	6	1	1	17	19	0.004
MN	53	45	44	45	0	3	1	3	2	4	<.001
WI	34	38	53	35	1	7	5	4	7	15	<.001

Table A.3. Public opinion of prescribed fire

4. In my opinion, *mechanical vegetation removal* is:

	A legitimate tool that resource managers should be able to use whenever they see fit.		Something that should be done infrequently, only in carefully selected areas.		A practice that should not be considered because it creates too many negative impacts.		An unnecessary practice.		I know too little to make a judgment about this topic.		P-value (X^2 test)
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	59	62	26	24	3	2	3	2	9	10	<.001
AZ	76	75	16	10	3	3	2	0	3	12	0.249
CO	63	70	24	20	3	4	3	0	7	6	0.169
OR	67	68	21	22	6	1	1	1	4	7	0.002
UT	56	57	34	31	0	2	0	2	10	9	<.001
MI	47	50	31	32	4	3	4	4	15	12	0.012
MN	60	67	28	21	1	1	3	3	8	8	0.071
WI	50	52	26	27	4	2	5	1	15	17	0.001

Table A.4. Public opinion of mechanical vegetation removal

5. In my opinion, *thinning* is:

	A legitimate tool that resource managers should be able to use whenever they see fit.		Something that should be done infrequently, only in carefully selected areas.		A practice that should not be considered because it creates too many negative impacts.		An unnecessary practice.		I know too little to make a judgment about this topic.		P-value (X^2 test)
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	67	68	23	23	1	1	3	1	1	7	<.001
AZ	-	75	-	17	-	3	-	0	-	5	-
CO	-	76	-	20	-	0	-	0	-	4	-
OR	78	80	18	16	5	0	1	1	1	3	0.032
UT	-	62	-	26	-	1	-	0	-	10	-
MI	59	55	25	27	3	5	5	3	11	10	0.003
MN	74	71	19	24	1	0	3	1	3	4	0.171
WI	57	60	29	26	3	0	1	3	10	11	0.003

Table A.5. Public opinion of thinning

6. The use of *prescribed fire* may create concerns for some people. Please indicate how concerned you are about the following possible effects in your area.

a. Damage to private property.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	20	10	27	22	40	44	13	24	<.001
AZ	7	7	30	12	47	50	17	31	0.033
CO	20	14	38	41	35	34	7	11	0.344
OR	23	6	21	20	41	46	16	29	<.001
UT	21	8	28	25	38	52	13	15	0.038
MI	30	21	24	14	31	44	16	22	0.03
MN	16	6	27	22	42	48	14	24	0.001
WI	19	11	25	19	47	39	10	31	<.001

Table A.6. Concern regarding damage to private property

b. Decreased recreation opportunities.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	11	5	24	14	33	32	33	49	<.001
AZ	9	5	14	13	33	32	44	50	0.458
CO	7	4	20	19	35	33	38	44	0.381
OR	9	6	24	14	36	30	31	50	0.001
UT	13	5	28	21	32	43	27	31	0.046
MI	19	13	31	28	26	29	24	30	0.171
MN	8	2	20	16	32	34	39	48	0.016
WI	10	3	26	23	36	24	29	49	0.01

Table A.7. Concern regarding decreased recreation opportunities

c. Loss of wildlife habitat.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	19	12	24	27	28	28	28	32	0.024
AZ	14	12	17	27	33	30	33	32	0.409
CO	13	9	24	35	33	31	27	25	0.645
OR	19	11	23	16	26	27	31	46	0.001
UT	22	9	25	30	28	36	18	25	0.175
MI	27	19	26	26	25	33	22	22	0.246
MN	15	14	24	26	27	21	33	38	0.671
WI	20	13	26	25	25	34	29	28	0.163

Table A.8. Concern regarding loss of wildlife habitat

d. Risk of fire going out of control.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	31	27	24	33	33	32	13	9	0.266
AZ	14	31	17	32	45	32	24	5	<.001
CO	20	41	21	35	46	18	13	6	<.001
OR	22	21	13	31	36	40	29	7	0.006
UT	24	28	21	37	41	28	16	7	0.047
MI	54	29	17	24	21	35	7	11	<.001
MN	35	18	31	36	27	33	6	12	0.001
WI	35	25	38	33	22	33	5	10	0.006

Table A.9. Concern regarding fire going out of control

e. Economic loss of useable timber.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	13	12	22	26	27	31	37	30	0.027
AZ	7	12	12	17	29	28	52	43	0.188
CO	3	4	19	25	19	27	60	44	0.038
OR	16	15	27	21	24	31	34	34	0.596
UT	9	12	24	29	27	35	40	26	0.099
MI	18	19	26	28	22	32	35	22	0.228
MN	21	11	25	35	30	32	25	22	0.593
WI	13	14	22	26	38	33	28	27	0.392

Table A.10. Concern regarding the economic loss of useable timber

f. Reduced scenic quality.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	14	12	26	23	36	39	24	26	0.168
AZ	9	14	21	22	43	39	28	25	0.273
CO	10	10	23	25	43	42	24	23	0.909
OR	13	12	27	15	29	37	31	37	0.1
UT	18	12	25	33	38	39	19	16	0.911
MI	22	20	32	25	30	34	17	22	0.266
MN	8	7	26	22	38	42	27	28	0.45
WI	16	13	28	22	33	37	23	28	0.21

Table A.11. Concern regarding reduced scenic quality

g. Increased levels of smoke.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	18	12	26	28	32	37	24	22	0.149
AZ	14	17	36	24	24	44	26	15	0.604
CO	11	6	27	39	37	30	24	25	0.904
OR	21	13	23	32	29	44	27	12	0.908
UT	24	13	22	40	38	34	16	12	0.745
MI	23	19	28	29	28	28	23	24	0.615
MN	13	12	21	22	34	37	31	28	0.85
WI	18	9	26	14	36	46	20	31	<.001

Table A.12. Concern regarding increased levels of smoke

h. Deteriorated public water supply.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	18	9	19	16	31	32	32	42	<.001
AZ	10	7	26	14	24	36	40	43	0.122
CO	14	7	23	24	37	37	26	32	0.184
OR	21	13	23	15	29	23	27	49	<.001
UT	25	8	18	24	37	45	21	24	0.038
MI	23	14	19	22	19	31	39	33	0.713
MN	15	5	16	10	33	34	36	51	<.001
WI	17	11	13	9	34	23	36	57	0.004

Table A.13. Concern regarding deteriorated public water supply

i. Increased soil erosion.

	Great concern		Moderate concern		Slight concern		Not a concern		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	22	13	27	26	34	37	18	24	<.001
AZ	12	17	29	24	40	34	19	25	0.905
CO	17	11	34	35	41	41	7	13	0.212
OR	23	13	24	19	37	39	17	29	0.006
UT	31	13	29	39	24	40	16	8	0.301
MI	26	14	30	29	30	29	14	28	0.006
MN	17	9	19	24	37	37	26	29	0.136
WI	23	15	27	16	30	37	20	32	0.001

Table A.14. Concern regarding increased soil erosion

7. How much confidence do you have in the forest agency in your area to use the following practices as part of a responsible and effective fuels management program?

a. Confidence in forest agency to use prescribed fire.

	Full		Moderate		Limited		None		No Opinion		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	18	22	43	43	27	21	7	7	6	7	0.126
AZ	25	34	52	41	18	20	5	5	0	0	0.695
CO	13	10	49	51	32	23	4	10	1	6	0.504
OR	13	29	59	36	19	23	6	10	3	1	0.678
UT	13	25	43	51	37	13	3	4	3	6	0.008
MI	14	15	36	37	20	23	13	5	18	19	0.314
MN	23	21	43	49	24	22	3	5	6	2	0.833
WI	22	21	27	35	33	22	12	11	6	10	0.595

Table A.15. Confidence in forest agency to use prescribed fire

b. Confidence in forest agency to use mechanical vegetation removal.

	Full		Moderate		Limited		None		No Opinion		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	25	26	41	38	21	20	5	8	8	8	0.317
AZ	35	33	40	38	15	21	10	3	0	5	0.828
CO	21	25	44	38	27	16	1	16	7	6	0.458
OR	28	35	46	36	21	21	3	8	3	0	0.557
UT	18	31	49	40	25	19	0	3	8	7	0.419
MI	23	21	33	37	18	19	6	10	21	14	0.597
MN	27	25	47	41	16	21	3	7	7	7	0.219
WI	23	20	32	35	26	24	10	9	8	12	0.827

Table A.16. Confidence in forest agency to use mechanical vegetation removal

c. Confidence in forest agency to use thinning

	Full		Moderate		Limited		None		No Opinion		P-value
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	31	29	39	36	16	20	6	7	9	7	0.075
AZ	-	32	-	41	-	19	-	3	-	5	-
CO	-	24	-	39	-	20	-	13	-	4	-
OR	35	44	46	27	12	23	6	6	6	0	0.758
UT	-	33	-	36	-	16	-	4	-	10	-
MI	31	24	35	38	15	19	5	6	15	14	0.194
MN	33	27	47	37	11	24	3	6	6	5	0.032
WI	27	25	31	36	24	20	8	8	6	11	0.645

Table A.17. Confidence in forest agency to use thinning

8. Which of the following items reflect your opinion about *smoke from prescribed fire*?

Please check ***all*** the answers that apply to you.

	Smoke from prescribed fire has never been an issue for me		Smoke from prescribed fire is a necessary inconvenience		Smoke from prescribed fire is a concern, but I think it is managed acceptably		I worry about the effects of smoke on public health		I worry about the effects of smoke on travel safety		Because of the smoke, prescribed fire isn't worth it	
	% Agree		**% Agree**		**% Agree**		**% Agree**		**% Agree**		**% Agree**	
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**
Total[a]	34	46*	39	59*	53	45	34	22*	27	13*	6	5
AZ	35	29	55	75*	48	62	28	25	20	5*	3	5
CO	39	51	56	63	48	47	27	20	20	11	6	0
OR	23	36*	52	64	56	47	39	20*	37	16*	6	7
UT	29	32	44	52	50	41	40	29	29	16	10	3
MI[b]	38	52	32	46	54	35	-	30	-	25	-	10
MN[b]	32	53	27	68	62	47	-	17	-	14	-	3
WI[b]	37	60	24	51	53	39	-	17	-	3	-	3

* p-value <0.05

[a] Western states only

[b] Different scales used in 2002 and 2008, no comparisons calculated

Table A.18. Opinion of smoke from prescribed fire

9. Agency managers use various programs to provide information about management activities. How helpful and trustworthy have the following sources of information been to you?

Check the "no experience" box if you've had no experience with an information source.

Note: Only participants with experience responded to the helpful and trustworthy questions.

a. Informational brochures.

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		Slightly		Very		Yes		No	
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**
Total	36	45	7	9	46	50	48	41	89	92	11	8
AZ	24	51	5	14	38	36	58	50	95	91	5	10
CO	34	38	10	5	27	56	63	39	95	97	5	3
OR	19	39	6	5	40	40	54	55	94	97	6	3
UT	42	52	3	7	58	63	39	30	100	96	0	4
MI	50	53	8	13	47	56	44	31	86	80	14	20
MN	31	43	8	10	47	52	45	39	80	91	20	9
WI	44	41	6	8	61	49	33	43	75	91	25	9

Table A.19. Ratings of informational brochures

b. TV public service messages.

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		**Slightly**		**Very**		**Yes**		**No**	
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**
Total	12	31	8	12	49	52	43	36	76	90	24	10
AZ	13	32	4	5	41	42	54	53	91	97	9	3
CO	27	53	15	19	49	53	36	28	81	80	19	20
OR	16	29	6	7	39	49	55	44	89	95	11	5
UT	11	23	5	6	52	60	43	34	89	90	11	11
MI	13	28	15	13	44	53	41	33	64	88	36	12
MN	3	23	8	18	51	46	41	37	71	87	29	13
WI	7	31	5	11	59	63	36	26	61	92	39	8

Table A.20. Ratings of television public service messsages

c. Visitor centers and interpretive signs

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		Slightly		Very		Yes		No	
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**
Total	24	34	6	7	40	40	53	53	92	93	8	7
AZ	7	45	4	7	27	48	69	45	96	92	4	8
CO	11	40	9	3	35	51	56	46	93	94	7	6
OR	14	29	4	7	23	45	74	48	96	93	4	8
UT	17	29	6	9	32	37	63	54	92	92	4	8
MI	36	32	13	9	51	41	36	50	86	90	14	10
MN	32	33	6	8	45	30	48	62	94	93	6	8
WI	35	31	4	7	68	37	28	56	87	96	13	4

Table A.21. Ratings of visitor centers and interpretive signs

d. Internet web pages.

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		Slightly		Very		Yes		No	
	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008
Total	64	72	27	25	41	38	31	37	63	86	37	14
AZ	77	69	17	22	33	22	50	56	67	93	33	7
CO	66	69	13	29	39	33	48	38	86	100	14	0
OR	73	69	13	30	53	45	33	25	71	88	29	12
UT	67	70	48	21	38	37	14	42	61	83	39	17
MI	62	76	35	38	38	38	27	25	42	82	58	18
MN	54	74	29	8	41	50	29	42	59	81	41	19
WI	56	73	27	32	43	36	30	32	64	79	36	21

Table A.22. Ratings of internet web pages

e. Guided field trips to forest sites

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		Slightly		Very		Yes		No	
	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008
Total	54	71	9	34	30	32	61	34	93	83	7	17
AZ	64	79	16	50	16	17	68	33	88	78	12	22
CO	53	82	7	25	30	42	63	33	93	100	7	0
OR	58	68	4	35	22	30	74	35	96	93	4	7
UT	55	70	11	21	32	32	57	47	100	75	0	25
MI	57	67	16	46	28	32	56	23	90	76	10	24
MN	45	68	8	25	31	46	62	29	92	83	8	17
WI	54	68	5	38	43	21	53	42	92	83	8	17

Table A.23. Ratings of guided field trips to forest sites

f. Government public meetings.

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		Slightly		Very		Yes		No	
	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008
Total	50	61	20	27	45	47	36	26	64	77	36	24
AZ	54	64	17	29	33	24	50	48	76	88	24	13
CO	62	62	21	24	42	60	38	16	57	88	44	13
OR	70	60	12	42	65	33	24	25	67	85	33	15
UT	57	68	37	20	48	70	15	10	40	71	60	29
MI	49	68	40	33	29	42	32	25	62	75	38	25
MN	38	62	9	28	48	47	43	25	76	63	24	37
WI	33	51	13	18	50	53	37	30	63	77	37	24

Table A.24. Ratings of government public meetings

g. Conversations with agency staff.

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		Slightly		Very		Yes		No	
	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008
Total	46	55	11	13	32	41	57	46	79	88	21	12
AZ	49	58	22	16	26	48	52	36	67	84	33	16
CO	44	54	8	7	31	45	61	48	88	96	12	4
OR	42	59	12	12	27	35	62	54	76	90	24	10
UT	52	56	7	11	58	30	36	59	74	96	26	4
MI	56	59	18	21	33	52	49	28	75	88	25	13
MN	36	52	5	14	25	41	69	46	88	82	12	18
WI	44	50	10	10	33	38	57	52	76	86	24	14

Table A.25. Ratings of conversations with agency staff

h. Newsletters.

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		Slightly		Very		Yes		No	
	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008
Total	48	58	10	18	53	53	37	30	80	85	20	15
AZ	55	59	4	13	44	52	52	35	91	89	9	11
CO	45	59	11	4	51	63	38	33	94	95	6	5
OR	57	44	4	14	44	49	52	37	83	97	17	3
UT	49	57	6	15	55	62	39	23	90	68	10	32
MI	46	61	15	31	61	46	24	23	76	79	24	21
MN	40	63	13	18	52	65	36	18	73	79	27	21
WI	48	57	12	27	60	35	29	38	67	85	33	15

Table A.26. Ratings of newsletters

i. Educational workshops.

	No experience		How helpful is the information to you?						Trustworthy?			
			Not		Slightly		Very		Yes		No	
	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008
Total		72		29		31		40	-	86	-	14
AZ	-	69	-	28	-	28	-	44	-	93	-	7
CO	-	80	-	17	-	33	-	50	-	100	-	0
OR	61	71	5	39	27	22	68	39	92	85	8	15
UT	-	77	-	14	-	29	-	57	-	91	-	9
MI	-	76	-	59	-	24	-	18	-	70	-	30
MN	-	70	-	26	-	37	-	37	-	86	-	14
WI	-	63	-	20	-	37	-	43	-	82	-	18

Table A.27. Ratings of educational workshops

j. Sites demonstrating management practices (asked only in 2008 survey).

	No experience	How helpful is the information to you?			Trustworthy?	
	-	Not	Slightly	Very	Yes	No
Total	66	21	38	41	89	12
AZ	72	31	19	50	92	8
CO	75	6	53	41	100	0
OR	58	23	39	39	91	9
UT	66	19	33	48	79	21
MI	68	26	30	44	88	12
MN	61	17	40	43	88	13
WI	64	23	47	30	88	13

Table A.28. Ratings of sites demonstrating management practices

k. Agency managers who meet with homeowner groups (asked only in 2008 survey).

	No experience	How helpful is the information to you?			Trustworthy?	
	-	Not	Slightly	Very	Yes	No
Total	78	33	32	35	79	21
AZ	72	25	31	44	100	0
CO	78	20	40	40	90	10
OR	79	46	23	31	78	22
UT	83	27	36	36	78	22
MI	81	54	31	15	88	13
MN	77	29	24	48	63	38
WI	76	37	37	26	69	31

Table A.29. Ratings of agency managers who meet with homeowner groups

10. In your opinion, how well has the forest agency in your area *incorporated public concerns* into its management strategies?

	Excellent, public concerns are always considered		Good, public concerns are usually considered		Fair, public concerns are sometimes considered		Poor, public concerns are rarely considered		I have no basis for an opinion on this topic		P-value (X^2 test)
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	
Total	5	8	32	39	38	25	14	8	12	20	<.001
AZ	7	19	37	45	40	21	16	5	-	10	-
CO	6	4	42	46	48	22	5	7	-	20	-
OR	6	11	26	35	31	27	20	3	17	24	<.001
UT	2	5	31	38	54	28	14	9	-	20	-
MI	4	3	22	39	26	24	17	12	31	22	0.511
MN	5	12	32	34	35	23	8	10	19	21	0.381
WI	6	6	33	37	34	29	17	7	9	22	0.096

Table A.30. Ratings of agency incorporation of public concerns

11. Public land management often involves difficult trade-offs between natural environmental conditions (wildlife, old growth forests) and economic considerations (employment, tax revenues). Please locate yourself on the following scale concerning these issues. 1 = highest priority should be given to maintaining natural environmental conditions even if there are negative economic consequences, 7 = highest priority should be given to economic considerations even if there are negative environmental consequences, 4 = both environmental and economic factors should be given equal priority.

	1		2		3		4		5		6		7		Mean Score		P-value
	02	08	02	08	02	08	02	08	02	08	02	08	02	08	02	08	
Total	11	7	12	8	15	10	47	53	10	12	4	8	1	1	3.5	3.7	0.001
AZ	10	7	5	5	13	9	58	56	8	9	3	11	2	4	3.7	4	0.069
CO	25	18	28	19	13	18	25	34	7	4	1	7	1	0	2.7	3.1	0.01
OR	6	4	10	13	14	4	52	52	16	17	3	8	0	1	3.7	4	0.03
UT	3	6	6	5	19	11	56	63	8	6	7	8	0	0	3.8	3.8	0.925
MI	-	8	-	8	-	6	-	53	-	13	-	11	-	1	-	3.9	-
MN	-	2	-	3	-	11	-	63	-	13	-	5	-	2	-	4.1	-
WI	-	8	-	6	-	14	-	49	-	16	-	5	-	1	-	3.8	-

Table A.31. Environmental/Economic orientation

12. How would you rate the overall condition of public forests in your area?

	Very healthy		Somewhat healthy		Somewhat unhealthy		Very unhealthy		Don't know	
	2002	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**	**2002**	**2008**
Total	3	15	14	47	49	24	29	5	5	9
AZ	-	9	-	47	-	33	-	7	-	4
CO	-	0	-	24	-	59	-	10	-	7
OR	-	59	-	44	-	35	-	7	-	7
UT	-	15	-	49	-	21	-	0	-	16
MI	4	20	11	53	50	7	25	6	8	14
MN	3	24	18	52	50	12	24	4	6	8
WI	2	25	12	54	48	13	37	1	2	7

Table A.32. Overall condition of public forests, comparative data

Section 2: The following questions were asked only in the 2008 survey

1. How would you rate the overall condition of public forests in your area?

	Very healthy	Somewhat healthy	Somewhat unhealthy	Very unhealthy	Don't know
Total	15	47	24	5	9
AZ	9	47	33	7	4
CO	0	24	59	10	7
OR	59	44	35	7	7
UT	15	49	21	0	16
MI	20	53	7	6	14
MN	24	52	12	4	8
WI	25	54	13	1	7

Table A.33. Overall condition of public forests, 2008 data

2. Have there been any wildfires in your area in the last six years?

	Yes	No
Total	56	44
AZ	76	24
CO	66	34
OR	78	22
UT	93	7
MI	40	60
MN	38	62
WI	28	72

Table A.34. Recent wildfire occurrence

If yes, please answer the following….
a. About how far away from your home was the wildfire?

	less than 1 mile	1-5 miles	more than 5 miles
Total	4	48	48
AZ	0	53	47
CO	0	50	50
OR	8	51	42
UT	2	47	52
MI	9	41	50
MN	5	49	46
WI	12	35	54

Table A.35. Proximity of homes to recent wildfires

b. Did you experience discomfort from smoke?

	Yes	No
Total	45	55
AZ	73	27
CO	43	57
OR	66	34
UT	58	42
MI	16	84
MN	24	76
WI	0	100

Table A.36. Experience with smoke from recent wildfires

c. Were you evacuated?

	Yes	No
Total	4	96
AZ	9	91
CO	4	96
OR	7	93
UT	0	100
MI	0	100
MN	5	95
WI	0	100

Table A.37. Evacuations from recent wildfires

d. Did you suffer damage to your personal property?

	Yes	No
Total	0	100
AZ	0	100
CO	0	100
OR	2	98
UT	0	100
MI	0	100
MN	0	100
WI	0	100

Table A.38. Damage to personal property from recent wildfires

3. How likely do you think it is that *prescribed burning* will generate the following outcomes?

a. Reduce scenic quality.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	9	16	27	30	13	5
AZ	10	10	24	37	17	2
CO	10	16	36	26	9	3
OR	9	12	27	30	22	0
UT	6	21	27	30	9	6
MI	13	14	28	21	14	10
MN	6	22	22	39	9	1
WI	9	16	26	26	13	10

Table A.39. Beliefs that prescribed fire will reduce scenic quality

b. Create more smoke in the short-term, but less smoke over time.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	15	33	24	11	7	10
AZ	15	45	15	12	8	5
CO	20	30	29	6	6	9
OR	22	41	15	13	3	6
UT	9	29	37	8	5	12
MI	10	16	26	21	12	16
MN	16	42	21	11	4	6
WI	15	29	24	9	9	15

Table A.40. Beliefs that prescribed fire will create more smoke in the short-term, but less smoke over time

c. Save money by reducing the cost of fighting a wildfire.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	24	34	20	9	7	6
AZ	33	37	12	10	7	2
CO	25	39	25	4	4	3
OR	42	33	12	1	7	4
UT	18	43	25	6	1	6
MI	10	28	21	13	13	15
MN	32	35	20	8	4	1
WI	14	29	23	14	9	10

Table A.41. Beliefs that prescribed fire will save money by reducing the cost of fighting a wildfire

d. Restore forests to a more natural condition.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	23	36	18	8	9	6
AZ	25	42	17	5	7	5
CO	22	50	12	4	6	6
OR	36	35	17	3	9	0
UT	16	36	21	12	7	7
MI	14	28	14	15	17	12
MN	29	36	23	5	4	2
WI	16	29	20	11	15	9

Table A.42. Beliefs that prescribed fire will restore forests to a more natural condition

e. Improve conditions for wildlife.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	23	32	20	9	9	8
AZ	25	30	17	8	7	13
CO	20	32	25	10	7	6
OR	31	32	19	4	7	6
UT	17	38	21	11	5	9
MI	17	27	19	10	17	10
MN	32	36	17	5	6	4
WI	16	27	24	12	12	8

Table A.43. Beliefs that prescribed fire will improve conditions for wildlife

f. Effectively reduce fire risk.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	27	34	21	7	6	5
AZ	38	35	12	5	8	2
CO	26	39	20	6	4	4
OR	43	30	20	0	3	3
UT	18	38	25	11	3	5
MI	18	27	22	12	12	10
MN	35	37	19	4	3	1
WI	15	32	26	13	5	8

Table A.44. Beliefs that prescribed fire will effectively reduce fire risk

4. How likely do you think it is that *thinning* will generate the following outcomes?

a. Reduce scenic quality.

	Extremely likely	Very Likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	4	9	22	35	27	5
AZ	7	7	22	33	25	7
CO	1	10	23	36	25	4
OR	3	4	14	38	39	1
UT	3	8	26	41	17	6
MI	9	8	14	31	31	6
MN	1	9	24	36	28	1
WI	2	12	26	29	22	9

Table A.45. Beliefs that thinning will reduce scenic quality

b. Extract useable wood products.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	28	40	15	9	3	5
AZ	20	37	20	14	2	7
CO	26	39	20	7	4	4
OR	32	38	19	7	3	1
UT	23	44	14	14	2	5
MI	23	40	8	12	5	12
MN	32	42	16	7	2	1
WI	33	37	13	4	6	7

Table A.46. Beliefs that thinning will extract useable wood products

c. Save money by reducing the cost of fighting a wildfire.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	27	33	21	8	5	6
AZ	42	30	10	8	3	7
CO	21	44	24	6	3	1
OR	38	43	9	3	1	6
UT	28	30	27	4	4	6
MI	16	29	17	16	13	10
MN	33	32	26	6	2	1
WI	14	29	27	10	10	10

Table A.47. Beliefs that thinning will save money by reducing the cost of fighting a wildfire

d. Restore forests to a more natural condition.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	21	30	24	10	8	7
AZ	31	32	19	7	3	8
CO	21	43	20	7	3	6
OR	35	35	19	6	1	4
UT	12	33	22	13	9	10
MI	13	17	30	16	17	8
MN	26	28	25	10	8	2
WI	10	28	29	8	14	11

Table A.48. Beliefs that thinning will restore forests to a more natural condition

e. Improve conditions for wildlife.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	21	30	24	10	7	8
AZ	27	27	20	7	3	17
CO	17	37	26	9	6	6
OR	28	38	18	3	7	6
UT	15	27	38	12	2	6
MI	15	17	26	12	21	10
MN	30	33	18	11	3	4
WI	13	33	24	15	8	8

Table A.49. Beliefs that thinning will improve conditions for wildlife

f. Effectively reduce fire risk.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	27	33	21	8	6	6
AZ	43	28	18	0	3	7
CO	25	41	23	3	6	3
OR	35	45	13	3	1	3
UT	24	30	28	9	3	6
MI	17	26	19	17	12	9
MN	34	33	20	8	3	2
WI	16	27	23	13	10	10

Table A.50. Beliefs that thinning will effectively reduce fire risk

g. Result in more harvesting than necessary.

	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely	Don't know
Total	7	9	18	31	26	8
AZ	10	8	23	27	22	10
CO	4	7	20	33	26	10
OR	7	7	7	33	39	6
UT	0	11	23	44	14	9
MI	12	8	18	30	18	13
MN	4	12	14	35	34	2
WI	9	8	24	20	29	10

Table A.51. Beliefs that thinning will result in more harvesting than necessary

5. How much you trust the forest agency in your area to conduct specific management activities. (Based on a 7-point scale from *strongly disagree* to *strongly agree*)

a. I trust the agency to respond to and fight forest fires.

	Disagree			Neutral	Agree			Mean Score
Scale #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Total	1	2	2	11	15	31	37	5.7
AZ	2	2	3	3	7	23	60	6.2
CO	0	4	0	11	20	33	31	5.7
OR	0	0	3	11	21	24	40	5.9
UT	0	0	3	6	21	42	27	5.8
MI	5	2	0	21	12	32	27	5.4
MN	1	3	2	6	12	31	44	6
WI	6	4	13	23	23	19	12	5.4

Table A.52. Trust in forest agency to respond to and fight forest fires

b. I trust the agency to use thinning practices effectively.

	Disagree			Neutral	Agree			Mean Score
Scale #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Total	4	4	6	21	24	22	18	5
AZ	3	2	5	23	10	33	23	5.3
CO	4	6	7	15	31	14	23	5
OR	3	3	6	23	23	21	21	5.1
UT	0	2	3	24	30	33	6	5
MI	9	6	5	25	23	19	14	4.6
MN	4	6	7	18	22	20	22	5
WI	2	5	10	22	24	20	16	4.9

Table A.53. Trust in forest agency to use thinning practices effectively

c. I trust the agency to effectively plan and implement prescribed burns.

	Disagree			Neutral	Agree			Mean Score
Scale #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Total	6	4	11	20	25	20	12	4.6
AZ	10	3	5	14	25	25	17	4.8
CO	7	11	10	18	30	18	6	4.3
OR	7	1	11	16	24	20	20	4.9
UT	1	3	9	27	27	30	1	4.7
MI	9	5	9	28	26	15	9	4.4
MN	5	3	14	17	24	18	18	4.8
WI	6	4	13	23	23	19	12	4.6

Table A.54. Trust in forest agency to effectively plan and implement prescribed burns

6. Please tell us about your trust in information from the forest agency in your area about their management programs for reducing the risk of wildfire. (Based on a 7-point scale from *strongly disagree* to *strongly agree*)

a. I trust the agency to provide enough information so that I can decide on actions I should take about fire and fire safety.

	Disagree			Neutral	Agree			Mean Score
Scale #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Total	3	3	5	13	18	37	20	4.9
AZ	4	7	3	21	24	27	13	5.3
CO	6	3	3	18	24	25	21	4.9
OR	0	8	15	23	26	22	6	5.1
UT	5	4	4	31	26	22	8	4.6
MI	1	7	6	23	19	25	20	4.7
MN	4	5	8	26	25	19	13	5
WI	3	5	6	23	23	25	14	4.7

Table A.55. Trust in forest agency to provide adequate information

b. I trust the agency to provide current, timely information about forest fire issues.

	Disagree			Neutral	Agree			Mean Score
Scale #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Total	3	5	8	20	22	27	15	4.9
AZ	5	3	5	12	17	37	22	5.3
CO	1	7	6	19	27	30	10	4.9
OR	4	4	3	18	23	27	21	5.2
UT	0	9	12	15	27	29	8	4.8
MI	6	3	9	31	23	17	10	4.5
MN	3	4	9	16	16	31	20	5.1
WI	3	5	9	24	25	20	14	4.8

Table A.56. Trust in forest agency to provide current, timely information

c. I trust the agency to provide credible information about their fuel reduction activities.

	Disagree			Neutral	Agree			Mean Score
Scale #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Total	3	5	7	20	17	32	17	4.7
AZ	4	3	7	26	24	26	10	5
CO	4	4	10	18	23	21	20	4.8
OR	0	12	7	30	24	22	4	4.9
UT	8	3	6	35	23	19	5	4.5
MI	1	8	8	23	18	26	15	4.4
MN	5	9	8	29	26	15	8	4.9
WI	4	6	8	26	22	23	11	4.4

Table A.57. Trust in forest agency to provide credible information

7. Please tell us if your trust in the forest agency in your area has *changed* over the last six years because of how it has handled its fire and fuel management activities.

My trust in the agency has:

	Increased	Not changed	Decreased
Total	14	74	11
AZ	32	52	17
CO	11	79	10
OR	24	59	17
UT	9	84	7
MI	10	78	12
MN	8	80	10
WI	10	82	9

Table A.58. Change in level of trust in forest agency

8. How much have the following influenced your opinion of the forest agency practices in your area to reduce the risk of wildfire?

a. Media (TV, newspapers).

	Not at all	Slightly	Moderately	A great deal
Total	32	28	29	11
AZ	22	28	33	17
CO	37	28	24	10
OR	35	29	28	9
UT	26	32	32	9
MI	40	21	30	9
MN	28	34	28	10
WI	36	23	28	13

Table A.59. Influence of media on public opinion

b. My neighbors.

	Not at all	Slightly	Moderately	A great deal
Total	58	19	16	7
AZ	55	11	25	9
CO	47	26	20	8
OR	66	12	15	6
UT	69	14	14	3
MI	53	25	14	8
MN	57	19	18	7
WI	61	21	11	7

Table A.60. Influence of neighbors on public opinion

c. City or county fire department.

	Not at all	Slightly	Moderately	A great deal
Total	33	25	28	13
AZ	21	21	36	22
CO	31	31	25	14
OR	29	20	27	24
UT	32	32	27	9
MI	42	26	27	5
MN	38	22	28	12
WI	36	26	28	10

Table A.61. Influence of city or county fire department on public opinion

d. Forest agency in your area.

	Not at all	Slightly	Moderately	A great deal
Total	18	26	39	17
AZ	12	19	39	30
CO	18	26	43	12
OR	16	17	36	31
UT	17	35	43	5
MI	26	31	28	15
MN	17	24	43	16
WI	17	26	42	15

Table A.62. Influence of local forest agency on public opinion

e. Threat of a wildfire in my area.

	Not at all	Slightly	Moderately	A great deal
Total	29	26	27	18
AZ	14	16	46	23
CO	19	25	33	23
OR	18	27	22	33
UT	30	35	25	10
MI	39	22	28	11
MN	34	27	28	11
WI	36	28	24	13

Table A.63. Influence of wildfire threat on public opinion

f. An actual wildfire occurring in my area.

	Not at all	Slightly	Moderately	A great deal
Total	36	22	23	19
AZ	14	16	46	23
CO	30	33	12	25
OR	23	21	20	36
UT	31	22	31	16
MI	45	15	21	18
MN	45	25	19	10
WI	54	19	16	11

Table A.64. Influence of actual wildfire occurrence on public opinion

9. Have you taken action on your property to protect your home from wildfires?

	Yes	No
Total	44	56
AZ	68	32
CO	58	42
OR	66	34
UT	25	75
MI	24	76
MN	36	64
WI	41	59

Table A.65. Level of action taken to protect home from wildfire

10. Agency interactions with the local community.

a. The agency is open to public input and uses it to shape management decisions.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
Total	5	14	41	6	34
AZ	3	10	40	16	31
CO	3	9	47	1	40
OR	4	11	37	10	38
UT	5	14	40	2	40
MI	5	15	38	1	40
MN	5	16	36	7	35
WI	7	17	50	7	19

Table A.66. Citizen-agency interactions, incorporating public input into management decisions

b. Agency managers usually create plans without input from local communities.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
Total	5	28	21	8	37
AZ	9	28	23	9	32
CO	4	31	21	6	38
OR	11	31	11	7	39
UT	3	26	23	8	40
MI	0	29	22	7	42
MN	4	24	23	8	40
WI	6	28	26	10	30

Table A.67. Citizen-agency interactions, incorporating public input into management plans

c. Agency managers build trust and cooperation with local citizens.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
Total	4	16	41	6	33
AZ	3	12	37	19	29
CO	4	10	49	1	35
OR	1	11	44	6	38
UT	5	15	45	2	34
MI	3	19	37	4	37
MN	4	19	37	7	33
WI	8	23	39	3	26

Table A.68. Citizen-agency interactions, building trust and cooperation

d. Managers do a good job of providing information about management activities.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
Total	3	18	41	6	31
AZ	3	16	43	17	21
CO	4	13	46	3	34
OR	1	13	46	6	34
UT	5	22	39	3	31
MI	7	19	32	1	41
MN	2	21	36	9	31
WI	2	21	45	6	26

Table A.69. Citizen-agency interactions, providing information about management activities

e. I am skeptical of information from the forest agency in my area.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
Total	18	37	17	6	21
AZ	40	26	14	4	16
CO	22	41	15	4	18
OR	23	43	16	3	16
UT	13	47	16	5	20
MI	8	36	18	5	33
MN	15	31	23	8	23
WI	15	37	17	10	21

Table A.70. Citizen-agency interactions, skepticism of agency information

f. There are adequate opportunities for citizens to participate in the local agency planning process.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
Total	4	19	32	5	40
AZ	7	14	29	14	36
CO	3	9	43	4	41
OR	3	11	42	3	41
UT	6	22	25	2	46
MI	7	19	27	3	45
MN	1	24	24	6	44
WI	6	26	35	3	30

Table A.71. Citizen-agency interactions, providing adequate opportunities for citizen participation in planning processes

g. Local agency staff are prohibited from doing their jobs because of national restrictions or regulations.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't know
Total	4	15	19	10	51
AZ	10	12	16	12	50
CO	3	18	16	10	53
OR	4	8	24	18	45
UT	5	14	17	6	58
MI	3	16	18	4	59
MN	4	18	19	8	51
WI	3	15	25	14	43

Table A.72. Citizen-agency interactions, influence of national restrictions on local agency

12. Public opinion and support are important factors in the success of forest policies. We want to know what influences your opinion of management decisions. Rate each of the following factors 1 through 7 (1 = not important, 7 = extremely important) on how important they are when making judgments about forest agency actions and decisions in your area.

a. When local citizens have been included in the planning process.

	1	2	3	4	5	6	7	Mean
Total	1	2	7	20	23	28	20	5.3
AZ	0	2	10	17	22	26	22	5.3
CO	0	4	10	11	35	28	11	5.1
OR	2	0	6	29	21	20	23	5.2
UT	0	0	6	20	26	28	20	5.4
MI	1	3	7	24	21	20	24	5.2
MN	2	2	4	20	18	30	23	5.3
WI	1	2	6	16	18	40	18	5.4

Table A.73. Importance of citizen inclusion in the planning process on judgments of forest agency actions

b. How the decision affects my personal property.

	1	2	3	4	5	6	7	Mean
Total	5	3	5	18	15	24	30	5.3
AZ	10	3	7	21	2	22	34	5.1
CO	1	6	7	18	15	25	27	5.2
OR	4	7	0	16	13	25	35	5.4
UT	3	0	5	22	26	20	25	5.3
MI	5	4	4	16	12	24	34	5.3
MN	6	0	4	12	16	21	40	5.6
WI	7	2	5	21	20	26	19	5

Table A.74. Importance of personal property implications on judgments of forest agency actions

c. When I know the objectives of a proposed management action.

	1	2	3	4	5	6	7	Mean
Total	1	2	6	21	26	27	18	5.2
AZ	0	4	4	25	14	29	25	5.4
CO	0	3	4	12	35	29	17	5.4
OR	0	0	5	22	27	31	16	5.3
UT	0	0	5	25	32	26	12	5.2
MI	1	1	6	28	25	19	20	5.1
MN	2	2	6	18	27	24	20	5.2
WI	2	2	9	22	19	31	15	5.1

Table A.75. Importance of knowing management objectives on judgments of forest agency actions

d. The decision maintains forest access for recreation.

	1	2	3	4	5	6	7	Mean
Total	2	2	7	17	26	26	21	5.2
AZ	0	5	11	11	30	16	28	5.3
CO	3	4	10	21	23	24	14	4.9
OR	1	1	7	18	28	21	24	5.3
UT	0	0	3	18	21	36	21	5.6
MI	1	1	7	20	18	34	19	5.3
MN	4	1	8	10	28	25	24	5.3
WI	0	1	4	22	23	32	17	5.2

Table A.76. Importance of maintaining recreational forest access on judgments of forest agency actions

e. The decision leads to active management to maintain or restore conditions.

	1	2	3	4	5	6	7	Mean
Total	1	1	5	24	29	27	13	5.1
AZ	0	0	5	29	25	21	20	5.2
CO	1	0	1	21	31	21	24	5.4
OR	0	0	3	27	29	29	12	5.2
UT	0	0	6	27	33	30	4	5
MI	1	4	11	23	27	23	10	4.8
MN	0	0	3	15	36	34	11	5.4
WI	1	1	7	31	21	28	10	5

Table A.77. Importance of maintaining or restoring conditions on judgments of forest agency actions

f. My trust in the decision-maker.

	1	2	3	4	5	6	7	Mean
Total	2	2	7	23	23	27	16	5.1
AZ	2	3	9	16	26	22	22	5.2
CO	1	0	4	23	32	26	13	5.1
OR	3	0	7	27	19	33	10	5
UT	0	0	3	30	24	36	7	5.2
MI	4	1	7	22	22	29	14	5
MN	1	3	10	19	19	25	22	5.2
WI	0	4	8	26	22	22	17	5

Table A.78. Importance of trust in the decision-maker on judgments of forest agency actions

g. Environmental consequences are given top priority.

	1	2	3	4	5	6	7	Mean
Total	2	3	10	24	21	22	18	5
AZ	5	0	19	19	28	9	21	4.7
CO	0	9	4	14	21	24	27	5.3
OR	1	6	19	21	24	16	13	4.6
UT	1	1	9	33	22	19	13	4.9
MI	3	3	8	26	18	22	22	5
MN	0	1	8	22	23	32	13	5.2
WI	1	2	8	34	16	22	17	5

Table A.79. Importance of giving top priority to environmental considerations on judgments of forest agency actions

h. When scientists play a role by reviewing management alternatives.

	1	2	3	4	5	6	7	Mean
Total	3	4	7	24	26	24	13	4.9
AZ	0	4	11	32	18	19	18	4.9
CO	3	3	0	24	30	27	13	5.1
OR	2	2	11	24	23	29	11	4.9
UT	0	2	5	22	37	25	11	5.1
MI	8	8	7	26	18	23	10	4.5
MN	3	3	9	22	20	26	16	5
WI	3	4	9	20	34	20	10	4.8

Table A.80. Importance of the role that scientists play on judgments of forest agency actions

i. Visual impacts of the activity.

	1	2	3	4	5	6	7	Mean
Total	1	5	13	24	24	20	12	4.8
AZ	2	7	16	24	26	14	12	4.6
CO	0	7	14	20	31	19	9	4.7
OR	0	6	10	36	23	13	12	4.6
UT	0	3	6	20	34	26	11	5.1
MI	3	8	9	20	23	20	16	4.8
MN	0	3	16	26	14	23	17	4.9
WI	2	4	15	21	24	24	9	4.7

Table A.81. Importance of visual impacts on judgments of forest agency actions

j. When actions help support the local economy.

	1	2	3	4	5	6	7	Mean
Total	2	6	10	33	23	15	10	4.5
AZ	2	5	17	34	12	17	12	4.5
CO	3	14	14	42	19	3	4	3.9
OR	1	3	6	34	21	24	10	4.8
UT	2	3	3	37	31	17	8	4.7
MI	3	7	11	33	27	12	7	4.4
MN	2	5	8	19	31	23	11	4.9
WI	3	6	11	39	19	9	13	4.4

Table A.82. Importance of supporting the local economy on judgments of forest agency actions

k. Economic consequences are given top priority.

	1	2	3	4	5	6	7	Mean
Total	3	6	14	36	19	15	6	4.3
AZ	5	10	7	33	24	7	14	4.4
CO	9	10	22	35	16	9	0	3.7
OR	1	4	13	28	22	26	4	4.7
UT	2	3	14	41	17	20	5	4.5
MI	5	7	11	31	19	19	8	4.4
MN	1	3	16	34	25	14	6	4.5
WI	2	5	15	45	11	13	8	4.3

Table A.83. Importance of giving top priority to economic considerations on judgments of forest agency actions

13. Are you retired?

	No	Yes
Total	48	52
AZ	37	63
CO	70	30
OR	48	52
UT	62	38
MI	38	62
MN	44	56
WI	41	59

Table A.84. Number of retirees in study

14. Does your community have a Community Wildfire Protection Plan?

	No	Yes	Don't know
Total	13	24	63
AZ	12	50	38
CO	16	33	51
OR	10	45	45
UT	12	13	75
MI	12	12	77
MN	16	16	67
WI	14	12	75

Table A.85. Amount of communities with a Community Wildfire Protection Plan

15. Do you belong to a homeowners association or property group that has (or is organizing) a fire-safe or similar program to create more open space around neighborhood homes?

	No	Yes	If so, is this program required?	If so, is this program voluntary?
Total	90	10	16	84
AZ	78	22	31	69
CO	87	13	11	89
OR	72	28	18	82
UT	97	3	0	100
MI	96	4	0	100
MN	97	3	0	100
WI	96	4	0	100

Table A.86. Membership in community defensible space organization

16. How concerned are you that a wildfire could change your quality of life?

	Not too concerned	Somewhat concerned	Very concerned	Extremely concerned
Total	34	29	23	14
AZ	32	33	18	17
CO	19	31	31	19
OR	21	35	23	21
UT	43	37	13	7
MI	34	34	22	9
MN	28	38	23	11
WI	34	41	17	7

Table A.87. Concern regarding a wildfire impacting quality of life

Appendix B: Frequency Report of Northern Lake States' Responses

Table values are percents unless otherwise noted.

1. Please evaluate the following methods in terms of how often they are utilized by your management area to achieve your forest restoration and/or fuel reduction methods.

a. Prescribed fire.

	Never	Rarely	Sometimes	Often	Always
Total	3	12	38	38	9
MI	6	13	59	22	0
MN	0	12	30	42	15
WI	0	13	13	63	12

Table B.1. Amount of prescribed fire use in the northern lake states

b. Wildland fire use.

	Never	Rarely	Sometimes	Often	Always
Total	49	31	17	1	1
MI	44	34	19	3	0
MN	55	27	15	0	3
WI	50	31	17	1	1

Table B.2. Amount of wildland fire use in the northern lake states

c. Mechanized thinning.

	Never	Rarely	Sometimes	Often	Always
Total	4	9	24	58	6
MI	0	13	22	59	6
MN	6	6	21	58	9
WI	6	6	31	56	0

Table B.3. Amount of mechanized thinning use in the northern lake states

d. Mowing.

	Never	Rarely	Sometimes	Often	Always
Total	12	25	35	28	0
MI	9	25	41	25	0
MN	18	27	33	21	0
WI	6	19	25	50	0

Table B.4. Amount of mowing use in the northern lake states

e. Herbicide.

	Never	Rarely	Sometimes	Often	Always
Total	20	30	33	16	1
MI	13	47	31	9	0
MN	30	21	36	12	0
WI	13	13	31	38	6

Table B.5. Amount of herbicide use in the northern lake states

2. Does your management area utilize the following methods primarily to restore forest conditions, to reduce forest fuels, or both?

a. Prescribed fire.

	Restore forest conditions	Both	Reduce forest fuels	We don't use this practice
Total	15	78	5	3
MI	6	81	6	6
MN	12	82	6	0
WI	38	63	0	0

Table B.6. Prescribed fire utilization to accomplish management objectives

b. Wildland fire use.

	Restore forest conditions	Both	Reduce forest fuels	We don't use this practice
Total	11	25	1	63
MI	13	22	3	63
MN	9	27	0	64
WI	13	25	0	63

Table B.7. Wildland fire use to accomplish management objectives

c. Mechanized thinning.

	Restore forest conditions	Both	Reduce forest fuels	We don't use this practice
Total	27	57	11	5
MI	25	63	6	6
MN	30	46	21	3
WI	25	69	0	6

Table B.8. Mechanized thinning utilization to accomplish management objectives

d. Mowing.

	Restore forest conditions	Both	Reduce forest fuels	We don't use this practice
Total	27	25	25	24
MI	25	28	22	25
MN	24	21	24	30
WI	38	25	31	6

Table B.9. Mowing utilization to accomplish management objectives

e. Herbicide.

	Restore forest conditions	Both	Reduce forest fuels	We don't use this practice
Total	43	19	6	32
MI	44	22	9	25
MN	39	12	3	46
WI	50	25	6	19

Table B.10. Herbicide utilization to accomplish management objectives

3. Of these methods, are there any that you would like to use more than you are currently able to?

a. Prescribed fire.

	Yes	No
Total	95	5
MI	97	3
MN	91	9
WI	100	0

Table B.11. Satisfaction with amount of prescribed fire utilization

b. Wildland fire use.

	Yes	No
Total	64	36
MI	72	28
MN	61	39
WI	56	44

Table B.12. Satisfaction with amount of wildland fire use

c. Mechanized thinning.

	Yes	No
Total	52	48
MI	37	63
MN	58	42
WI	69	31

Table B.13. Satisfaction with amount of mechanized thinning utilization

d. Mowing.

	Yes	No
Total	23	77
MI	16	84
MN	30	70
WI	25	75

Table B.14. Satisfaction with amount of mowing utilization

e. Herbicide.

	Yes	No
Total	30	70
MI	28	72
MN	30	70
WI	31	69

Table B.15. Satisfaction with amount of herbicide utilization

4. How much do the following factors influence your forest restoration and/or fuel management decisions?

a. Budget constraints.

	Not at all	Slightly	Moderately	A great deal
Total	0	7	35	58
MI	0	6	38	56
MN	0	12	27	61
WI	0	0	44	56

Table B.16. Influence of budget constraints on management decisions

b. Laws (e.g. NEPA, ESA).

	Not at all	Slightly	Moderately	A great deal
Total	5	48	33	14
MI	0	59	28	13
MN	12	33	39	15
WI	0	56	31	13

Table B.17. Influence of laws on management decisions

c. Habitat requirements (e.g. Kirtland's warbler or other species).

	Not at all	Slightly	Moderately	A great deal
Total	9	31	47	14
MI	6	22	53	19
MN	9	39	42	9
WI	13	31	44	13

Table B.18. Influence of habitat requirements on management decisions

d. Competing agency interests (e.g. recreation, timber, wildlife).

	Not at all	Slightly	Moderately	A great deal
Total	3	26	44	27
MI	3	31	44	22
MN	3	27	49	21
WI	0	13	38	50

Table B.19. Influence of competing agency interests on management decisions

e. Agency mandates.

	Not at all	Slightly	Moderately	A great deal
Total	9	38	35	19
MI	3	34	41	22
MN	9	42	33	15
WI	19	38	25	19

Table B. 20. Influence of agency mandates on management decisions

f. Interface constraints (e.g. presence of homes, public safety).

	Not at all	Slightly	Moderately	A great deal
Total	4	30	40	27
MI	0	22	47	31
MN	9	36	30	24
WI	0	31	44	25

Table B.21. Influence of interface constraints on management decisions

g. Pressure from public stakeholders.

	Not at all	Slightly	Moderately	A great deal
Total	6	44	41	9
MI	6	56	34	3
MN	9	36	39	15
WI	0	38	56	6

Table B.22. Influence of pressure from public stakeholders on management decisions

h. Your forest plan.

	Not at all	Slightly	Moderately	A great deal
Total	14	35	37	15
MI	9	50	28	13
MN	12	24	46	18
WI	25	25	38	13

Table B.23. Influence of forest plan on management decisions

i. Past personal experiences.

	Not at all	Slightly	Moderately	A great deal
Total	21	43	27	9
MI	16	44	31	9
MN	30	30	33	6
WI	13	69	6	13

Table B.24. Influence of past personal experiences on management decisions

j. Previous agency actions (e.g. normal operating procedures).

	Not at all	Slightly	Moderately	A great deal
Total	12	35	37	16
MI	6	31	41	22
MN	21	27	39	12
WI	6	56	25	13

Table B.25. Influence of previous agency actions on management decisions

k. The scientific community (e.g. researchers).

	Not at all	Slightly	Moderately	A great deal
Total	28	48	17	6
MI	28	53	13	6
MN	36	39	21	3
WI	13	56	19	13

Table B.26. Influence of the scientific community on management decisions

l. Professional societies.

	Not at all	Slightly	Moderately	A great deal
Total	56	37	6	1
MI	50	47	3	0
MN	64	30	6	0
WI	50	31	13	6

Table B.27. Influence of professional societies on management decisions

5. There are several different places one can get information. Please rate how often you use the following sources to get information on fire management and forest restoration.

a. Management colleague.

	Never	Rarely	Sometimes	Often	Always
Total	0	2	17	63	17
MI	0	3	16	53	28
MN	0	3	18	79	0
WI	0	0	19	50	31

Table B.28. Use of management colleagues in information exchange

b. Agency research scientist.

	Never	Rarely	Sometimes	Often	Always
Total	6	20	35	31	9
MI	9	13	44	25	9
MN	6	30	24	33	6
WI	0	13	38	38	13

Table B.29. Use of agency research scientists in information exchange

c. Academic research scientist.

	Never	Rarely	Sometimes	Often	Always
Total	5	24	48	24	0
MI	6	22	53	19	0
MN	6	21	46	27	0
WI	0	31	44	25	0

Table B.30. Use of academic research scientists in information exchange

d. Professional society.

	Never	Rarely	Sometimes	Often	Always
Total	17	46	24	14	0
MI	16	38	28	19	0
MN	15	58	18	9	0
WI	25	38	25	13	0

Table B.31. Use of professional societies in information exchange

6. There are several different methods used to communicate information. Please indicate how useful each of the following methods are to exchanging information on fire management and forest restoration.

a. Conferences/professional meetings.

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	0	9	31	52	7	1
MI	0	13	38	41	6	3
MN	0	0	30	55	6	0
WI	0	0	19	69	13	0

Table B.32. Usefulness of conferences/professional meetings to information exchange

b. Trips to field sites/demonstration sites.

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	0	3	16	48	33	0
MI	0	0	22	44	34	0
MN	0	3	12	52	33	0
WI	0	6	13	50	31	0

Table B.33. Usefulness of trips to field sites to information exchange

c. Virtual meetings (video teleconference or online webinars).

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	6	31	48	11	0	4
MI	3	25	53	13	0	6
MN	9	36	49	6	0	0
WI	6	31	38	19	0	6

Table B.34. Usefulness of virtual meetings to information exchange

d. Telephone conference with multiple participants.

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	4	44	42	9	0	1
MI	0	41	41	19	0	0
MN	3	49	46	3	0	0
WI	13	44	38	0	0	6

Table B.35. Usefulness of telephone conferences to information exchange

e. General Technical Reports.

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	0	25	37	32	6	0
MI	0	31	31	31	6	0
MN	0	21	33	39	6	0
WI	0	19	56	19	6	0

Table B.36. Usefulness of General Technical Reports to information exchange

f. Condensed research summaries (e.g. 1 to 2 page summaries of findings and implications).

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	1	12	33	41	12	0
MI	3	19	31	38	9	0
MN	0	9	39	39	12	0
WI	0	6	25	50	19	0

Table B.37. Usefulness of condensed research summaries to information exchange

g. Newsletters from professional societies (e.g. SAF).

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	7	40	35	16	1	1
MI	6	44	34	16	0	0
MN	12	33	33	21	0	0
WI	0	44	38	6	6	6

Table B.38. Usefulness of newsletters from professional societies to information exchange

h. Newsletters from research organizations (e.g. the USFS Northern Research Station).

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	5	21	43	24	7	0
MI	6	22	38	25	9	0
MN	3	24	42	24	6	0
WI	6	13	56	19	6	0

Table B.39. Usefulness of newsletters from research organizations to information exchange

i. Internet web sites maintained by professional societies.

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	7	28	37	20	2	5
MI	6	16	41	25	3	9
MN	3	49	30	18	0	0
WI	19	13	44	13	6	6

Table B.40. Usefulness of internet web sites maintained by professional societies to information exchange

j. Internet web sites maintained by research organizations.

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	5	19	42	24	9	3
MI	6	13	41	25	9	6
MN	3	30	33	24	9	0
WI	6	6	63	19	6	0

Table B.41. Usefulness of internet web sites maintained by research organizations to information exchange

k. Email listserves used to provide scientific information.

	Not at all	Slightly	Moderately	Very	Extremely	No Opinion
Total	12	28	38	12	6	3
MI	16	34	31	9	6	3
MN	6	27	42	18	6	0
WI	19	19	44	6	6	6

Table B.42. Usefulness of email listserves to information exchange

7. Please indicate your level of agreement with each of the following statements regarding challenges you face to acquiring the best information to help you achieve your fire and restoration objectives.

a. The information is not easily accessible.

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
Total	3	21	35	36	6
MI	0	22	31	44	3
MN	3	21	39	30	6
WI	6	19	31	31	13

Table B.43. Information accessibility as a challenge to information exchange

b. I don’t have the time to look for the latest information.

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
Total	3	11	19	47	21
MI	3	6	34	44	13
MN	0	18	0	49	33
WI	6	6	25	50	13

Table B.44. Time as a challenge to information exchange

c. I don’t know where to look for the information.

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
Total	2	36	30	27	5
MI	3	34	25	28	9
MN	0	46	27	24	3
WI	6	19	44	31	0

Table B.45. Knowing where to look as a challenge to information exchange

d. I have concerns about the credibility of the currently available information.

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
Total	3	37	44	14	2
MI	0	53	31	13	3
MN	3	27	52	15	3
WI	6	25	56	13	0

Table B.46. Information credibility as a challenge to information exchange

e. The available information is not applicable to my situation.

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
Total	4	26	36	31	4
MI	3	28	44	25	0
MN	3	24	30	33	9
WI	6	25	31	38	0

Table B.47. Information applicability as a challenge to information exchange

8. Currently, do you, or management personnel in general, have a means to help shape the information that is generated through ongoing/future research?

	Yes	No	Unsure
Total	46	22	32
MI	50	19	31
MN	42	27	30
WI	44	19	38

Table B.48. Managers' perceived role in shaping research information

9. As the network further develops, are you interested in participating in additional activities? (e.g. receive invitations for workshops, virtual meetings, and other future communication activities)

	Yes	No
Total	90	10
MI	84	16
MN	94	6
WI	94	6

Table B.49. Managers' desire to be involved in future information exchange activities