

PRESCRIBED FIRE:
INFLUENCES ON COMMUNITY SUPPORT AND
MANAGEMENT ACTIVITIES IN NORTHERN CALIFORNIA

By

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ABSTRACT

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Though the need for prescribed fire in forests and rangelands is widely recognized, its use remains subject to a range of constraints, from operational to social. Efforts have been made to identify these constraints, as their characterization may be critical to the expansion of prescribed fire activities. Past research has focused on management perspectives and public attitudes, as both influence the character and extent of regional prescribed fire use, yet little research has explored both contexts simultaneously. This study examined constraints on prescribed fire activities in northern California using a regional survey of prescribed fire managers and a qualitative study of landowners in a forest community. The survey included all district-level managers from six federal and state agencies and several tribes, NGOs, and timber companies. The survey was completed in spring 2009 with a response rate of 92% among agency managers (N=51) and 84% among all surveyed (N=70). On average, 51,680 acres (20,914 hectares) were treated with prescribed fire each year between 2006 and 2008. This area represents 0.4% of the total managed area included in the study and 38% of the area needed to fulfill objectives of the region's prescribed fire programs. On a scale of 1-

10 (1, not limiting – 10, extremely limiting), narrow burn window (average rating: 8.2), regulations (7.2), lack of adequate personnel (6.2), and environmental laws (6.1) were identified as the most important constraints on prescribed fire activity. Insurance limitations (3.5), preference for alternative strategies (4.3), and public opinion (4.6) were identified as least limiting. The qualitative study consisted of open-ended interviews with 25 Hayfork-area landowners representing almost 4,000 acres in 18 distinct ownerships. Landowner support for prescribed fire, though widespread, was highly conditional. Trust was the most important influence on support, related to perceptions of agency incompetence, past timber and wildfire management, and disregard for local knowledge. Public opinion was not identified by managers as a major constraint on prescribed fire activity in northern California, yet this and past research have documented increasing frustration within forest communities over a lack of public involvement in decision-making around fire and fuels management. Given the conditionality of community support for prescribed fire and the growing frustration by which support may be diluted, the enhancement of public opinion and trust may be more critical to the success of prescribed fire programs than managers indicated.

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TABLE OF CONTENTS

ABSTRACT.....	iii
ACKNOWLEDGEMENTS.....	v
TABLE OF CONTENTS.....	vi
LIST OF TABLES.....	ix
LIST OF FIGURES.....	xi
INTRODUCTION.....	1
Management Activities in Northern California.....	5
Influences on Management Activities.....	5
Community Support for Prescribed Fire.....	10
Public Support for Prescribed Fire.....	11
Influences on Public Support for Prescribed Fire.....	13
METHODS.....	20
Management Activities in Northern California.....	20
Procedure.....	20
Participants.....	22
Analysis.....	26
Community Support for Prescribed Fire.....	28
Site Description.....	28
Research Approach.....	33
Procedure and Participants.....	35

TABLE OF CONTENTS (CONTINUED)

Analysis..... 37

PART ONE: MANAGEMENT ACTIVITIES IN NORTHERN CALIFORNIA..... 38

Results..... 38

 Prescribed Fire Activity in Northern California..... 39

 Management Objectives for Prescribed Fire Programs..... 43

 Impediments to the Use of Prescribed Fire – Which Are Most Limiting?... 46

 Impediments – Differences Between Entities 48

 Impediments – Differences Between Public and Private Lands Managers... 52

 Impediments – Differences Between NW and NE California 53

 Satisfaction with Programs and Perceptions of Risk..... 53

Discussion..... 56

 Prescribed Fire Activity in Northern California..... 56

 Management Objectives in Prescribed Fire Programs 59

 Impediments to the Use of Prescribed Fire 61

PART TWO: COMMUNITY SUPPORT FOR PRESCRIBED FIRE..... 65

Results..... 65

 The Role of Fire 67

 Local Forest Health 71

 Need for Year-Round Management and Personal Responsibility..... 72

 Relationship with Land Managers and Impacts on Support..... 78

TABLE OF CONTENTS (CONTINUED)

Discussion..... 84

 Support for Prescribed Fire 84

 Influences on Support for Prescribed Fire..... 86

CONCLUSIONS..... 90

 Public Opinion..... 90

REFERENCES 94

APPENDIX A (Data Tables) 99

APPENDIX B (Survey Instrument)..... 106

APPENDIX C (Consent Form)..... 112

LIST OF TABLES

Table	Page
1	Positions held by survey respondents and management areas contacted, by agency, northern California, 2009. 25
2	Response rates for prescribed fire survey by entity, northern California, 2009..... 38
3	Area treated with prescribed fire (acres) by entity, northern California, 2006 to 2008. 41
4	Size of areas under management and areas treated with prescribed fire (ac.), by entity, northern California. 42
5	Mean ratings (with standard deviations) of management objectives for prescribed burning programs, by entity, northern California. (Scale of 1-10, with 1 being “not important” and 10 being “very important.”) Superscript differences denote significant differences in means across entities for specific objectives (result of Tukey-Kramer multiple comparisons test). (* $p < 0.05$)..... 45
6	Number of responses in each rating category for given impediments. (Scale of 1 to 10 with one being “not limiting” and 10 being “extremely limiting”). N=59..... 47
7	Mean ratings (with standard deviations) of impediments to prescribed fire by entity, northern California. (Scale of 1-10, with 1 being “not limiting” and 10 being “extremely limiting.”) Superscript letters denote significant differences in means across entities for specific impediments (result of Tukey-Kramer multiple comparisons test). (* $p < 0.05$) 49
8	Ratings of impediments to prescribed fire by federal, state, and private entities in northern California, 2009. (* $p < 0.05$) 51
9	Mean ratings of impediments to prescribed fire by public and private lands managers in northern California, 2009. (* $p < 0.05$) 52

LIST OF TABLES (CONTINUED)

10	Number of responses in each rating category for given statements, northern California prescribed fire survey, 2009. (Scale of 1 to 10 with 1 being “strongly disagree” and 10 being “strongly agree.”) N=59.	54
11	Prescribed fire activity in the United States, as documented in this research and past studies.	58
12	Characteristics of landowners and properties participating in a case study of perspectives on fire management, Hayfork, CA, 2009.....	65
13	Interview codes: the role of fire and local forest health. Hayfork, CA, 2009.....	70
14	Interview codes: forest management and prescribed fire. Hayfork, CA, 2009.....	77
15	Interview codes: USFS fire management. Hayfork, CA, 2009.....	83

LIST OF FIGURES

Figure		Page
1	A view of downtown. Hayfork, CA, September 2008.....	29
2	Aerial photo of the Hayfork Valley and surrounding forests.	31
3	A view of the Hayfork Valley. Photo: WRTC.....	32
4	Prescribed burn in the Bald Hills of Redwood National Park, September 2008.....	39
5	Mean ratings of management objectives for prescribed fire programs in northern California. Means were analyzed using a Kruskal-Wallis one-way ANOVA on ranks. Line notation denotes means that were not found to be significantly different as a result of a Kruskal-Wallis multiple comparisons z-value (Dunn's) test using a Bonferroni z-value.....	43
6	Mean ratings for impediments to prescribed fire programs in northern California. Means were analyzed using a Kruskal-Wallis one-way ANOVA on ranks. Line notation denotes means that were not found to be significantly different as a result of a Kruskal-Wallis multiple comparisons z-value (Dunn's) test using a Bonferroni z-value.	48
7	Forest near a home in Hayfork, CA. Landowner has removed shrubs and pruned trees to reduce fire hazard. April 2009.	74
8	Recently burned ponderosa pine/white oak stand on private property near Hayfork, CA. Landowner has been prescribed burning this stand approximately every three years since the 1970s. February 2009.	76
9	Air quality in the Hayfork Valley during the 2008 fire season.....	78

INTRODUCTION

Forest and fire management over the last century have left a legacy of high-density stands, elevated fuel loading, and increases in ecological and social risks from wildfire in many forest types across the western United States (Agee and Skinner 2005). The management paradigm has shifted in recent decades and the need for active management has been widely recognized (Gardner et al. 1985, Allen et al. 2002), yet the integration of proactive strategies remains a challenge. Paradoxically, suppression is still the most prominent fire management approach, and advances in fire suppression have only augmented the wildfire problem (Brown and Arno 1991). A range of treatments may be employed to deal with fuels and ameliorate fire hazard, yet opportunities for the simultaneous treatment of fuels and restoration of ecological process and character are few. Prescribed fire—fire ignited under known conditions of fuel, weather, and topography to achieve specified objectives (Agee 1993)—offers one such opportunity, and it maintains a blend of ecological, financial, and cultural potential unrivaled by other treatments (e.g., Husari and McKelvey 1996, Arno and Allison-Bunnell 2002, Anderson 2005). Yet there are many impediments to the use of prescribed fire, including technical, social, legal, economic, and administrative (Cleaves et al. 2000, Menning 2007).

Though prescribed fire is often justified by and practiced for ecological purposes, its planning and implementation are unquestionably social and political in nature. The use of prescribed fire in a given region depends on the alignment of several key elements,

including the interest and commitment of land managers, the support of both the local community and the general public, and the satisfaction of various laws and regulations. Thus, it is not surprising that the range of impediments listed above consists primarily of human factors. Even technical considerations, such as air quality, topography, and weather, are often framed by their larger social contexts; these contexts define standards and determine measures of acceptability for each technical consideration and circumstance.

In California, which is both heavily populated and increasingly affected by wildfire, the use of prescribed fire is undoubtedly affected by human factors. Over 1.3 million acres burned in wildfires in California in 2008, presenting a substantial burden—financial, emotional, and otherwise—for the state and its residents (National Interagency Fire Center 2009). The relatively high level of hazard posed by wildfire in California renders proactive management a priority, yet it also complicates both the use and acceptance of prescribed fire as such a strategy. For both fire managers and residential communities in California, prescribed fire may seem an undesirable risk in a state already afflicted by wildfire. Yet the need to reintroduce fire to many of California's ecosystems remains, as the area treated with prescribed fire in most areas is still well below the area burned under historic fire regimes (Husari and McKelvey 1996). The reintroduction of fire will, in California and beyond, depend on the identification of those dynamics by which its use is impeded.

Many studies have investigated perspectives on fire management and prescribed fire; studies of both fire managers and residents in fire-prone regions have illuminated

impediments to the emergence of proactive management strategies. Among fire managers, perceived impediments to the implementation of prescribed fire include air quality and smoke management regulations, environmental laws, public opinion, and lack of adequate funding, personnel, and intra-agency support, among others (Cleaves et al. 2000, Williamson 2007). For residents in fire-prone regions, air quality concerns, misunderstandings of the role of fire in local ecosystems, and lack of trust in land managers, among other things, have been shown to impede public support for prescribed fire activities (Shindler and Reed 1996, Kneeshaw et al. 2004, Winter et al. 2005, Liljeblad and Borrie 2006).

This study sought to characterize impediments to the use of prescribed fire in northern California. Like previous studies, this research recognized the critical role of human perspective in the implementation of prescribed fire. Unlike other studies, this one approached prescribed fire from both the management perspective and the public perspective. As demonstrated above, many studies have investigated either public or management perspectives on prescribed fire, yet studies that explore *both* perspectives in a given region are rare if not entirely absent. Incongruities between the two suggest that the ability to fully understand impediments to prescribed fire in a given region depends on the consideration of both. This research included two distinct studies, as illustrated in the following pages. One component was a survey of district-level fire managers across northern California, wherein management objectives, levels of prescribed fire activity, and impediments to the use of prescribed fire were identified and rated. The second part explored prescribed fire and fire management from a community perspective, as garnered

through a qualitative, participatory approach in the fire-prone forest community of Hayfork, CA. Each of these approaches offers distinct and important insights into prescribed fire in northern California. Though different, the two approaches complement and reflect upon one another, illuminating constraints on prescribed fire in ways neither could do on its own.

Management Activities in Northern California

Prescribed fire is used by a number of federal, state, local, tribal, and private entities. In northern California, such entities include the US Forest Service, the Bureau of Land Management, the National Park Service, the US Fish and Wildlife Service, Cal Fire, the California Department of Parks and Recreation, and several tribes, timber companies, and non-governmental organizations, among others. Fire use in northern California thus stems from a range of resource objectives and management approaches and faces a wide variety of complications and barriers. Though research has characterized impediments to land managers' use of prescribed fire, studies have focused primarily on the activities of the US Forest Service (e.g., Cleaves et al. 2000, Williamson 2007, Black et al. 2008). Though this research focused on a smaller geographic region than most, it had as a priority the inclusion of all major entities that use prescribed fire. Such inclusion was meant to garner a nuanced illustration of prescribed fire activity in the region, one that captured diverse perspectives and allowed for interagency comparisons.

Influences on Management Activities

Though there is a wealth of fire-related social science research, much of it focuses on public attitudes and not on the perspectives of fire managers. That said, there have been a handful of studies that focus specifically on fire managers and their perceptions of the risks and barriers associated with the use of prescribed fire.

Early work by Cortner et al. (1990) identified factors that influence the risk-taking behaviors of fire managers. Their research, which covered five US Forest Service regions in the west, included managers in three fire management contexts—escaped fire, prescribed fire, and long-range fire budget planning. Managers in the prescribed fire context were least likely to be risk-averse (i.e. avoiding risk); 27 percent of fire managers demonstrated risk-averse decision-making, whereas 73 percent demonstrated willingness to take risks. Analysis of regional differences showed that managers in the USFS Pacific Southwest Region (Region 5 – California) were the most risk-averse of prescribed fire managers in the five regions included in the study. This finding is of particular interest to this research in northern California, as the area is contained in Region 5. Of the factors that most influenced managers' risk-taking behavior, human safety, resources at risk, and public opinion were identified as most important. Geographic variation in this study's results demonstrates the importance of context in fire management; a range of context-specific variables may influence patterns of risk perception, decision-making, and implementation, pointing to the need for directed, region-specific research.

Several more recent studies have characterized prescribed fire activity and explored barriers to the increased use of prescribed fire. Cleaves et al. (2000) summarized activity levels, management objectives, and barriers to the use of prescribed fire for national forests across the United States, as reported by the ninety-five Fire Management Officers (FMOs) who responded to the survey. According to their results, approximately 908,120 acres (367,503 hectares) of U.S. national forest lands are treated

each year with prescribed fire.¹ Though the importance of specific management objectives varied by location, hazard reduction, wildlife habitat enhancement, and ecosystem management maintained the highest overall ratings of the objectives listed on the survey. Less important objectives included reforestation, pest management, and range improvement. Barriers to prescribed fire also varied by location, but air quality and smoke management regulations, funding shortfalls, narrow burn windows, and a lack of available personnel stood out as the most important barriers. Public opinion, wildland-urban interface impacts, liability, and the agency's risk-taking policies were seen as less important influences on burning activity.

Though the study by Cleaves et al. (2000) focused only on fire managers with the USFS, a similar study by Haines et al. (2001) included federal, state, and private fire managers in the southeastern United States. Responses from state and private interests were grouped and compared with responses from federal (USFS) respondents. Though some objectives and barriers were shared by the two groups (both identified hazard reduction and habitat enhancement for game birds/animals as objectives, and both identified regulations and liability as barriers), there were important differences between their responses. For example, state and private managers identified reforestation and vegetation control in established stands as two of the most important objectives of their prescribed burning programs,² whereas federal managers identified habitat improvement

¹ Prescribed fire, for the purposes of their study, included slash burning, management ignited fires, prescribed natural fire, and brush and range burns. It is important to note that this is a broader definition of prescribed fire than that employed in my research in northern California, as I did not include slash burning or prescribed natural fire.

² In this case, prescribed fire included slash burning and natural fuels burning.

for threatened/endangered species and reintroduction of fire to the ecosystem as two of their top objectives. Important barriers for state and private managers included public opinion and residential development, whereas shortages of personnel and narrow burn windows were two of the most important barriers identified by federal managers.

Differences in perspective highlighted by this study confirm the need for inclusive research. As demonstrated in this case, there can be a range of resource objectives and constraints influencing prescribed fire activity in any given region, and efforts to identify such factors must include all major entities for which prescribed fire is an important resource management tool.

Research by Williamson (2007) explored influences on management decisions in the wildland fire use (WFU) context. Williamson found that public perception, staff trust, external factors (such as resource availability and liability), and agency support were all important influences on line officers' decisions to authorize WFU. Yet intriguingly, the most important influence identified in Williamson's research was the personal commitment of managers to the value of their fire use programs. Managers who did not express high levels of personal commitment to the reintroduction of fire were significantly less likely to authorize WFU in their districts. This finding is especially revealing, as other similar studies (e.g., Cortner et al. 1990, Cleaves et al. 2000, and Haines et al. 2001) have neglected such explicitly subjective considerations in their research. Cleaves et al. alluded to the importance of a "manager's unique style or perspective" in making management decisions (2000: 3), but this influence was not accounted for in their survey instrument.

Though the research discussed above explores the relative importance of various spheres of influence on prescribed fire activity, other research has investigated specific spheres in more detail. Such research focuses specifically on technical (e.g., Menning 2006), social (e.g., Shindler and Reed 1996, Kneeshaw et al. 2004, Winter et al. 2005, Liljeblad and Borrie 2006), legal (e.g., Yoder et al., Sun 2006), economic (e.g., Cleaves et al. 2000, Berry and Hesseln 2004, Husari and McKelvey 1996) and other impediments to the use of prescribed fire.

Legal research has characterized the implications of different classifications of prescribed fire liability present in the United States (e.g., Yoder et al. 2003, Sun 2006). Such classifications can heavily influence prescribed fire activity, especially as practiced by private landowners lacking sufficient insurance against escaped burns. Thus, relaxed liability classifications are in some cases due to pressures imposed by private interests rather than public (Sun 2006), pointing to the importance of including both private and public perspectives in prescribed fire research.

Economic research has focused on both the cost of prescribed fire and influences on costs. Cleaves et al. (2000) estimated the average cost of prescribed fire treatments across the U.S. to be \$78.13 per acre. Costs varied greatly by location, but Region 5 (California) maintained the highest cost per acre of all regions included in the study (\$223.38/acre or \$552/hectare), on average at least \$100 more per acre than treatments in other regions. Research by Berry and Hesseln (2004) may explain this phenomenon, as they show that concerns in the wildland-urban interface (WUI) can substantially increase the cost of prescribed fire treatments, and a relatively high number of priority sites in

California are in the WUI. Nevertheless, prescribed fire is usually, on a per acre basis, drastically cheaper than fire suppression (Husari and McKelvey 1996), and it is often a lack of prioritization rather than high costs that limits its use. Financial support for proactive management strategies consistently remains second to that for fire suppression, and funds set aside for pre-suppression activities are often shifted to cover suppression in big wildfire years (Menning 2007). The combination of lack of funding and funding instability renders the planning and implementation of prescribed fire a constant challenge.

Following the model employed by Cleaves et al. (2000) and Haines et al. (2001), this research in northern California sought to characterize prescribed fire activity and rate management objectives and barriers to the use of prescribed fire. Like Haines et al. (2001), this research included federal, state, and private land managers and thus offers a broad vision of prescribed fire activity in the region and opportunities for comparisons.

Community Support for Prescribed Fire

Of all the spheres that influence the use of prescribed fire, the social is one of the most researched. For decades, researchers have attempted to characterize both levels of public support and influences on public support for prescribed fire in the United States. Public opinion has been identified as one of the most important barriers to fire use activities (Cortner et al. 1990, Cleaves et al. 2000, Williamson 2007), and it is also one of the most dynamic, as it engages myriad elements of experience, perception, and place and can be highly context-specific (Shindler et al. 2002, Brunson and Shindler 2004,

Kneeshaw et al. 2004). Such dynamism often makes it difficult to gauge, understand, or generalize about public attitudes and perceptions, hence the wide range of like research in different communities and geographical locations.

Public Support for Prescribed Fire

Given the extensive discourse and concern surrounding public support for alternative fire management strategies, it may come as a surprise that public support is fairly high. Early studies of public attitudes toward fire showed widespread fear of wildfire and support for full suppression efforts (e.g., Hendee et al. 1968, Hall 1972, Folkman 1973), yet research has documented a shift in public attitudes and perceptions. Starting in the early 1980s, research has increasingly demonstrated public acceptance of alternative fire management practices, including prescribed fire (e.g., Cortner et al. 1984, Gardner et al. 1985, Shindler and Toman 2003, Brunson and Shindler 2004, McCaffrey 2005, Absher and Vaske 2005). In 1984, Cortner et al. found that two thirds of Tucson, AZ residents supported the use of prescribed fire by land managers. Similarly, in a 1985 study of attitudes towards fuels treatments, Gardner et al. found that 60 percent of national forest users supported flexible fire management strategies and the use of prescribed fire.³

More recent studies show equal or higher levels of support for prescribed fire. In a summary of related literature, McCaffrey (2005) showed that levels of public support for prescribed fire currently hover around 80 percent. New research published in the

³ “Forest users,” in this case, included organized groups representing a wide range of interests and forest uses. Such groups were distributed across eight of the nine USFS administrative regions (Gardner et al. 1985).

same year supported McCaffrey's assertion. In a study of four western states (Arizona, Colorado, Oregon, and Utah), Brunson and Shindler found that a "substantial majority" of residents in select fire-prone communities supported the use of prescribed fire, mechanical removal, and grazing as fuels management strategies (2004: 668).⁴ Though respondents in this study preferred that prescribed fire be used more sparingly than the other two treatments, they nonetheless widely approved of its use. Likewise, Absher and Vaske (2005) found that 82 percent of respondents in Colorado wildland urban interface (WUI) areas approved of prescribed fire activities by land management agencies. Several decades ago, levels of public support for proactive strategies may have been in question, yet at this point, research demonstrates that the public generally understands and supports the use of pre-suppression activities; changes in attitude have most likely occurred as a result of larger paradigm shifts in fire management and increased local experiences with fire and fuels treatments.

If public support for prescribed fire and other fuels treatments is fairly high, as the literature suggests, why is there a continued interest in and emphasis on public perception and acceptance within management and academic circles? For one, there is always room for improvement in this area, as no region boasts one hundred percent approval ratings for prescribed fire or other fuels treatment options. Secondly, the issues and concerns that communities have with such strategies tend to be context-specific; they reflect the

⁴ Communities surveyed in each state were chosen based on the following specific criteria: 1. Wildfire is significant disturbance in their area, 2. Federal land management agencies in the area have proposed reducing fuels with the methods assessed in the study, 3. Agencies have used public outreach and education strategies in those communities, and 4. Population growth in the WUI is above national averages in the area (Brunson and Shindler 2004).

natural and political histories of each region, thereby justifying similar research on a range of local and regional scales (Shindler et al. 2002, Brunson and Shindler 2004, Kneeshaw et al. 2004). Lastly, the relatively high levels of support demonstrated by the public for pre-suppression activities have been shown to be conditional—if the circumstances surrounding the use of such strategies do not satisfy the specific concerns held by a community, support can rapidly dissolve (Brunson and Evans 2005). The identification of these critical concerns is a central goal of research in this area, as support may be only nominal until such concerns are quelled.

Influences on Public Support for Prescribed Fire

A range of influences affects public support for prescribed fire. Such influences include issues specific to certain areas and communities, such as experience with fire and fuels treatments, and issues relevant on a broader scale, such as trust in land management agencies, perceptions of responsibility for fire mitigation, and air quality concerns.

As mentioned above, support for prescribed fire has been shown to be highly dependent on geographic location (Manfredo et al. 1990, Brunson and Shindler 2004, Kneeshaw et al. 2004, McCaffrey 2005), as even the need for fuels treatments is not uniformly acknowledged across diverse locales (Burns and Cheng 2007). Though the factors that influence support have been shown to be similar across regions (Winter et al. 2002), the extent to which they are expressed and understood differs by context. Support for prescribed fire tends to be higher in areas that are more familiar with the practice, such as Florida (McCaffrey 2005), and somewhat lower in areas that are less familiar, such as states in the west (Brunson and Shindler 2004, McCaffrey 2005). Likewise,

regions that have had more experience with fire, and are therefore more knowledgeable about fire processes and effects, are more likely to support prescribed burning (Gardner et al. 1985, Manfredo et al. 1990, Blanchard and Ryan 2004).

In a landmark study, Manfredo et al. (1990) demonstrated a direct relationship between fire experience and support for prescribed fire. Their research showed that fire knowledge and support were higher, on average, in Montana and Wyoming than they were nationally. Residents in the study area had just experienced the controversial Yellowstone fires of 1988 (where wildland fires were allowed to burn), yet their acceptance of prescribed fire was still relatively high.

On the other hand, communities that have experienced escaped prescribed fires may support the practice less than those that haven't (Winter et al. 2002, McCaffrey 2005). Escaped fires can diminish levels of public trust for land management agencies and enhance fear of fire use activities. Yet even the relationship between escaped burns and support is context-specific, as other research has shown it to be relatively insignificant in some areas (Brunson and Evans 2005). Brunson and Evans (2005) argue that though such communities may be more wary of prescribed fire, they may still maintain a steady level of conditional support for the practice. This conditionality is reflected in the influences on support described below, as issues such as responsibility and trust ultimately dictate the impact that experiences with wildfire and prescribed fire have on communities.

Trust is a key element of the prescribed fire discourse, as it both arises from and has the power to influence management actions. Many studies have found trust to be a

primary impediment to the implementation of prescribed fire and other fuels treatments (Winter et al. 2002, Shindler et al. 2002, Shindler and Toman 2003, Winter et al. 2004, Brunson and Evans 2005, McCaffrey 2005, Liljebblad and Borrie 2006, Vaske et al. 2007). Trust has also been shown to be one of the more common influences on support for fuels treatments. In focus group interviews in three WUI regions across the country (counties in California, Florida, and Michigan), trust emerged as a key influence in all sites (Winter et al. 2002). Though the context of trust issues varied by site, the outcome was similar in each region—trust was ultimately tied to perceptions of agency competence, professionalism, and ability to communicate with the public.

The relationships between trust, perceived agency competence, and perceived agency communication skills are echoed in other research. In their survey of WUI residents in California, Florida, and Michigan, Winter et al. (2004) found a strong relationship between trust and perceived agency competence in all sites.⁵ The question of competence also emerged in WUI areas in Colorado (Brenkert et al. 2006). In-depth interviews with residents in five WUI areas illuminated perspectives on wildfire mitigation and biophysical processes. The widespread perception of public lands as a threat spoke to the issue of agency competence and trust, as landowners in the study areas did not feel that agencies were doing their part to protect the national forest or adjacent private lands (Brenkert et al. 2006).

⁵ Though this research was performed in the same regions as earlier work by Winter et al. (2002), the methods and study population differed. Results from the 2002 focus group interviews were used to complement results of the 2004 survey, yet the survey results formed the bulk of research published in 2004.

Perceptions of competence are undoubtedly connected to the perceived communication skills of agencies. Though this connection has long been recognized by managers (e.g., Magill 1992), studies show that the public is increasingly unimpressed with agencies' efforts at communication and the integration of public input (Shindler and Toman 2003). A longitudinal study in Oregon and Washington, wherein respondents were surveyed in 1996 and again in 2000, showed few significant changes over time except in the trust arena (Shindler and Toman 2003). Respondents maintained relatively high levels of support for specific strategies, including prescribed fire, but indicated that their levels of trust in the US Forest Service to execute those strategies had declined. Only 27 percent of respondents in 2000 agreed that the USFS was doing a good job of communicating with the public, and the number of respondents who agreed that the USFS was open to using public input in shaping management plans decreased by 10 percent in the four year period—from 41 percent to 31 percent (Shindler and Toman 2003). Such issues may be tied in part to the perception that local agency staff has little control over management decisions, as top-down organization gives higher level officials ultimate authority.

Researchers widely agree that trust is an essential element of effective fire management (e.g., Winter et al. 2002, Shindler and Toman 2003, Winter et al. 2004, Brunson and Evans 2005, Liljeblad and Borrie 2006). As Liljeblad and Borrie (2006) argue, trust is essential to public evaluation of and support for fire management actions; they claim that “many of the political barriers to...fire use...may be remedied by addressing issues of trust between the public and managers” (2006: 39). Brunson and

Evans (2005) echo this sentiment, stressing the critical role that trust plays in determining the social acceptability of fuels treatments and fire management more generally. Both Liljeblad and Borrie (2006) and Brunson and Evans (2005), among others, assert that one of the most important objectives of land managers should be the development and maintenance of trust.

On a fundamental level, successful fire management also hinges on perceptions of responsibility. Discrepancies between management and public perspectives on responsibility can complicate fire management and reduce levels of support and trust. Research has explored the notion of responsibility in an effort to inform management activities and public education and outreach programs (Gardner and Cortner 1985, Cortner et al. 1990, Brenkert et al. 2006, Weisshaupt et al. 2007). In an early study, Gardner and Cortner (1985) found that residents in a fire-impacted community in southern California had done significantly less than a neighboring non-fire-impacted community to mitigate fire hazard. Likewise, homeowners in this region preferred mitigation strategies for which they did not have to directly be responsible (physically or financially). Thus, in this case, responsibility was perceived by WUI residents as being beyond them and in the hands of land managers and the government. More recent studies, however, have demonstrated increased self-reliance within WUI communities (e.g., Brenkert et al. 2006, Weisshaupt et al. 2007). For example, residents in five Colorado WUI areas shared the perception that wildfire risk mitigation on their properties and in their communities was their responsibility (Brenkert et al. 2006). Likewise,

stakeholders and residents in the northern Inland West⁶ agreed that although government agencies are responsible for managing and protecting the lands under their control, they do not necessarily owe protection to the people who choose to live in WUI areas (Weisshaupt et al. 2007). Perceptions of responsibility most likely vary by location and context, and the characterization of such perceptions for individual areas may be useful in understanding public perspective, building trust, and enhancing support for alternative fire management activities.

One of the more straightforward, universal impediments to prescribed fire is air quality. Air quality has been identified as a major influence on both management decisions and actions (e.g., Cleaves et al. 2000, Menning 2007) and public support for prescribed fire (e.g., Winter et al. 2002, McCaffrey 2005, Winter et al. 2005). Air quality impacts are far-reaching, affecting health, tourism, visibility, and business, and more. Air quality concerns are often discussed from a human health perspective, as smoke has been shown to be a health problem for up to 30 percent of individuals in some study areas (Shindler and Reed 1996, Winter et al. 2005). Impacts are particularly significant in human population subgroups where respiratory ailments, such as asthma, are more prominent (Winter et al. 2002). Smoke may also be considered an aesthetic issue, as it reduces visibility and impairs views, an issue of particular concern in tourist areas (Brunson and Shindler 2004). Visibility is of great concern to land managers, as well, as it may pose significant threats to human safety (Cleaves et al. 2000, Kneeshaw et al.

⁶ In this study, the northern Inland West refers to the “geographic area delineated by the crest of the Cascades in Washington to the Continental Divide in Montana, including northern Idaho” (Weisshaupt et al. 2007).

2004). Decreased visibility can be critical in WUI areas, where burning may take place near a highway or other well-traveled road.

Air quality concerns are difficult to remedy, yet they may be less of a problem in communities that recognize the “now-or-later” reality of fire—in their research, Winter et al. (2005) showed that attitudes toward prescribed burning in Missouri were significantly related to perceptions of smoke, as “the belief that prescribed burning meant more smoke now and less later was positively related to approval” (as summarized in McCaffrey 2005: 193). Such beliefs require reflection on and understanding of local context and history; if fire hazard and forest health are considered in a longitudinal context, and past conditions and future possibilities are taken into account, smoke may seem less of a problem. As the name suggests, prescribed burning is *prescribed*, and its implementation requires consideration of specific ambient conditions and smoke impacts. Smoke management considerations are necessarily included in prescribed burn plans and risk assessments (Cleaves et al. 2000). Under wildfire conditions, these factors are nearly impossible to control, and air quality impacts are often much worse than they would be if burning were prescribed.

METHODS

Management Activities in Northern California

In early spring 2009, a survey was distributed by email to district-level fire managers across the northern California. The survey asked managers to list the area treated with prescribed fire in their management areas for each of the last three years (2006, 2007, 2008), rate objectives for their prescribed burning programs, rate various barriers to the increased use of prescribed fire in their management areas, and respond to several questions concerning desired levels of fire use and willingness to take risks. Prescribed fire, as defined on the survey instrument (Appendix B), included only management-ignited broadcast burns and thus did not include slash burning or wildland fire use fires.

Procedure

Surveys are the most common research method used in social science research on fire management; they have been instrumental in research on both the public (e.g., Manfredi et al. 1990, Winter et al. 2004, Shindler and Toman 2003) and fire managers (e.g., Cortner et al. 1990, Cleaves et al. 2000, Williamson 2007). Surveys are one of the more efficient social science research tools, as they can be targeted to engage respondents in a large population or across a broad geographic area.

Though a popular method, there are several shortcomings to the use of surveys. Surveys can be expensive to administer, and it can also be difficult to achieve satisfactory response rates with a survey. Specific methods have been designed to address these issues, including the Tailored Design approach (Dillman 2000). As the name suggests, Tailored Design emphasizes survey procedures specific to each situation, wherein the development of respondent trust and interest are central to the survey approach. Usually, Tailored Design requires a personalized, iterative set of interactions with respondents; it may also include financial and other types of incentives to encourage participation. The use of internet technology, as opposed to postal mail and telephone, may also serve to cut costs associated with survey administration (Dillman 2000).

Following the basic tenets of the Tailored Design Method, I used a personalized, thorough approach to survey administration (Dillman 2000). Respondents were identified through an initial call to each ranger district or field office in the region. I asked the receptionist for the contact information of the primary prescribed fire manager in that district. Each manager was then contacted by phone before receiving the survey. This preliminary contact allowed me to fully explain my project and gave respondents the opportunity to ask questions or voice concerns. In order to maximize convenience and response rates and limit costs associated with administration, the survey was designed to be sent and filled out digitally. Thus, I was able to email the survey, with detailed instructions, to each individual directly after our phone conversation. If the completed survey was not emailed back within the following two weeks, I sent a reminder email

with the survey attached. This process continued until the completed survey was returned.

In addition to the survey instrument, each participant received a consent form that could be completed digitally and returned by email with the survey. The consent form provided information on the project and contact information for me and my faculty advisor, and it ensured participants that their responses would be kept confidential (see Appendix C). The survey instrument and consent form were reviewed by an NPS prescribed fire manager (John McClelland, Redwood National Park) before being distributed.

Participants

This survey focused on prescribed fire activities and influences in northern California. For the purposes of the survey, northern California included the area north of both the San Francisco Bay Area and the Tahoe Basin.⁷ The survey included a range of management agencies for which prescribed fire is a potential management tool. These agencies included the USDA Forest Service (USFS), the Bureau of Land Management (BLM), the National Park Service (NPS), the US Fish and Wildlife Service (USFWS), Cal Fire, and the California Department of Parks and Recreation (CDPR). The survey also included, to a more limited extent, tribes with forestry or fire management departments, non-governmental organizations (NGOs), and timber companies.

⁷ The Lake Tahoe Basin Management Unit and associated public lands (such as the Tahoe National Forest) were not included in the survey because of the range of extra social and regulatory influences present in that region.

In order to capture local subtleties and increase the number of respondents, surveys were distributed on as local a level as possible. The distinct organizational structure of each agency dictated the number of and types of positions held by potential respondents. Because all potential agency respondents were contacted, this study consisted of a census rather than a sample of fire managers (as in Williamson 2007).⁸

Managers with the USFS were contacted on a district level rather than on a national forest level. The survey was distributed to a total of 25 ranger districts and two national recreation areas in seven national forests. National forests included the Klamath, Shasta-Trinity, Six Rivers, Modoc, Mendocino, Plumas, and Lassen. Due to variation in staffing and duties within different ranger districts, contacts with the USFS represented a range of positions, including District Fire Management Officers, Assistant District Fire Management Officers (AFMOs), Fuels Officers, Fuels Planners, and Prescribed Fire Specialists (Table 1).

Managers with Department of Interior agencies also represented a range of positions. Contacts with BLM represented six field offices and included both Fire Management Officers (FMOs) and Prescribed Fire Specialists, depending on the office. Contacts with the NPS included FMOs, Fuels Technicians, and a Fire Ecologist and represented all NPS lands in the study area, including two national parks (Redwood and Lassen), two national recreation areas (Whiskeytown and Golden Gate), one national seashore (Point Reyes), and one national monument (Lava Beds). Contacts with the

⁸ The survey included a census of agency managers, but it only included a sub-sample of tribes, NGOs, and timber companies in the region.

USFWS included an FMO and a National Wildlife Refuge (NWR) manager and represented three NWRs (Klamath, Tule Lake, and Modoc).⁹

Managers from each of the nine Cal Fire Units in northern California were asked to participate in the survey. Generally, contacts were coordinators for regional Cal Fire Vegetation Management Programs, which provide resources and support for prescribed burning and other activities on private lands. Managers with CDPR all held environmental scientist positions and represented the six CDPR districts present in the study area.

The survey was distributed to eight major timber companies in northern California. Contacts included company Presidents, Chief Foresters, and Foresters. The survey was also distributed to six NGOs, including three fire safe councils and three non-profit organizations that emphasize forest restoration. Five northern California tribes were also contacted for the survey; these tribes all have land bases and forestry or fire management departments.

⁹ The FMO that participated in this study is in charge of all NWR burn plans in northern California. He felt that due to the lack of prescribed fire activity on certain NWRs in his region (such as the Castle Rock NWR and the Humboldt Bay NWR), it was unnecessary to include them in his survey response.

Table 1: Positions held by survey respondents and management areas contacted, by agency, northern California, 2009.

Agency	Management areas contacted	Types of positions held by respondents
USFS	<i>All Ranger Districts in:</i> Klamath National Forest Lassen National Forest Mendocino National Forest Modoc National Forest Plumas National Forest Six Rivers National Forest Shasta-Trinity National Forest	District Fire Management Officer Assistant District Fire Management Officer Fuels Officer Fuels Planner Prescribed Fire Specialist
BLM	Alturas Field Office Arcata Field Office Eagle Lake Field Office Redding Field Office Surprise Field Office Ukiah Field Office	Fire Management Officer Prescribed Fire Specialist
NPS	Golden Gate National Recreation Area Lassen National Park Lava Beds National Monument Point Reyes National Seashore Redwood National Park Whiskeytown National Recreation Area	Fire Management Officer Fuels Technician Fire Ecologist
FWS	Klamath National Wildlife Refuge Modoc National Wildlife Refuge Tule Lake National Wildlife Refuge	Fire Management Officer National Wildlife Refuge Manager
Cal Fire	Butte Unit Humboldt-Del Norte Unit Lassen-Modoc Unit Mendocino Unit Nevada-Yuba Unit Shasta-Trinity Unit Siskiyou Unit Sonoma-Lake-Napa Unit Tehama-Glenn Unit	VMP Coordinator Battalion Chief
CDPR	Diablo Vista District Marin District Mendocino District North Coast Redwoods District Northern Buttes District Russian River District	Environmental Scientist Senior Environmental Scientist Ecologist

Analysis

Survey data were organized in various ways to allow for comparisons. District-level burn data were aggregated for each entity, producing the following, by entity, for the survey region: total area under management; area treated with prescribed fire each year from 2006 to 2008; average area treated annually with prescribed fire from 2006 to 2008; annual area of prescribed fire treatment needed to fulfill management objectives; percent of managed area treated with prescribed fire each year (using average value from 2006 to 2008); and percent burned of area needed to fulfill management objectives.

Overall mean ratings (with standard deviations) were calculated for each management objective (n = 8) and impediment (n = 13) included in the survey. Mean ratings of individual management objectives were compared using a Kruskal-Wallis one-way ANOVA on ranks (data did not meet the assumptions required for a parametric ANOVA). Post-hoc analysis was completed with a Kruskal-Wallis multiple comparisons z-value (Dunn's) test using a Bonferroni z-value. The same tests were used to analyze differences among mean ratings of individual impediments.

Mean ratings (with standard deviations) of objectives, impediments, and statements¹⁰ were also calculated for each entity and analyzed with individual one-way ANOVA tests. To test for differences among entities, post-hoc analysis was completed with a Tukey-Kramer multiple comparisons test. The same tests were used to analyze differences between federal (n = 34), state (n = 13), and private entities (n = 12).

¹⁰ Includes four statements regarding satisfaction with prescribed fire programs, desire to burn more acres, and perceptions of risk.

Mean ratings (with standard deviations) of objectives, impediments, and statements were also calculated for two geographic regions (NE California (n = 22) and NW California (n = 36))¹¹ and entities that manage public lands (n = 40) and private (n = 19) lands.¹² Differences were analyzed with two-sample t-tests.

Statistical significance for all tests was determined at $\alpha = 0.05$ level. All statistical tests were conducted using NCSS (Hintze 2007).

¹¹ Interstate 5 was the geographic feature used to divide respondents by region.

¹² Cal Fire was grouped with entities that manage private lands, as much of their prescribed burning occurs on private lands through their Vegetation Management Program. Tribes were also grouped with private lands managers.

Community Support for Prescribed Fire

Though the survey of fire managers offered essential insight to the barriers to prescribed fire in northern California, it did not speak to the issues present in rural, fire-impacted communities in the region. As demonstrated previously, public perception can heavily influence prescribed fire activity, and only through the consideration of both manager and community perspectives may impediments to prescribed fire be fully illuminated in a given region. Hayfork, CA, a fire-prone forest community located within the Shasta-Trinity National Forest, offered a prime location for the exploration of critical public perspective.

Site Description

Hayfork is a small community nestled in one of two major alluvial valleys in the Klamath Mountains of northwestern California. Hayfork is located in Trinity County, one of the least populated counties in California, and it is surrounded by the Shasta-Trinity National Forest. A long history of forest management and wildfire, as well as an extensive and complicated relationship between the community and federal lands managers, made Hayfork well-suited for forest and fire research, both ecological and social. This study succeeds a host of related research in the Hayfork area, ranging from fire ecology and history (e.g., Taylor and Skinner 2003, Agee and Skinner 2005) to adaptive management (e.g., Everett 2001, Stankey et al. 2003) and community-based wildfire management (e.g., Danks 2000).



Figure 1: A view of downtown. Hayfork, CA, September 2008

The Hayfork community, like many others in northern California, was dependent on timber production for much of the last century. Seventeen different sawmills operated in the Hayfork area over the years (Belden 1996-1997), though by the 1990s, most activity was distilled to the Sierra Pacific Industries (SPI) mill just east of town. The SPI mill closed in 1996, heavily impacted by falling timber prices and forest restrictions imposed by the Northwest Forest Plan (NFP) (Danks 2000). Though the community struggled in the wake of these changes, a range of opportunities arose from Hayfork's unique location—next to one of ten Adaptive Management Areas (AMAs) established through the NFP—and its active, energetic community members. The Trinity Bioregion Group, established in 1993, brought diverse and often deeply polarized groups together to discuss contentious issues surrounding the forest and the community. It also set the stage for other collaborative resource groups, such as the Resource Advisory Committee, and fostered the development of both the Watershed Research and Training Center (WRTC)

and the Resource, Conservation, and Development (RC&D) Council (Middleton and Baker 2003).

As seen in Figures 2 and 3, Hayfork is entirely surrounded by forest. Though the valley maintains grasslands, shrublands, and oak woodlands, the larger landscape is dominated by mixed-conifer forests. There is great vegetative variation and complexity within the Klamath Mountains, yet the historic fire regime in most areas has been generally characterized as frequent with low- to moderate-intensity (Skinner et al. 2006). Historic ignitions were attributable both to lightning and the cultural burning practices of Native American groups in the region (Anderson 2005). Decreased fire occurrence and intense timber management over the last century altered vegetative composition and structure in the Hayfork area and resulted in a more homogenous landscape and increased fire hazard. As a result, the current era of fire suppression has featured—in contrast to historically frequent, low- to moderate-intensity fires—high severity wildfires that pose significant risks to local human and ecological communities (Skinner et al. 2006).

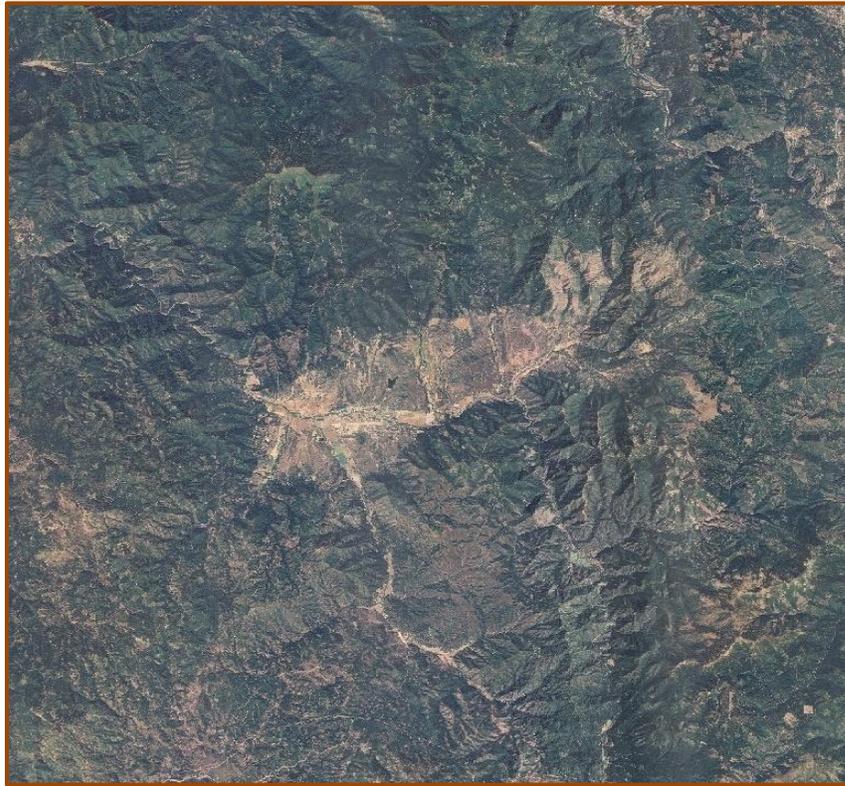


Figure 2: Aerial photo of the Hayfork Valley and surrounding forests.

Like many rural communities in northern California, Hayfork has been heavily affected by wildfire. Fires in 1987 burned 67,000 acres of local forestlands, 54,000 of those in the Hayfork Ranger District (representing nearly 19% of the total land base). In 1992, the Barker Fire burned 5,600 acres and in 2001, the Hyampom Fire burned approximately 1,200 acres and forced the evacuation of hundreds of Hayfork-area residents. The effects of other Trinity County wildfires, such as the Lowden Fire—an escaped prescribed burn—and the Big Bar Complex in 1999 and the Oregon Fire in 2001, have also resonated throughout the county.

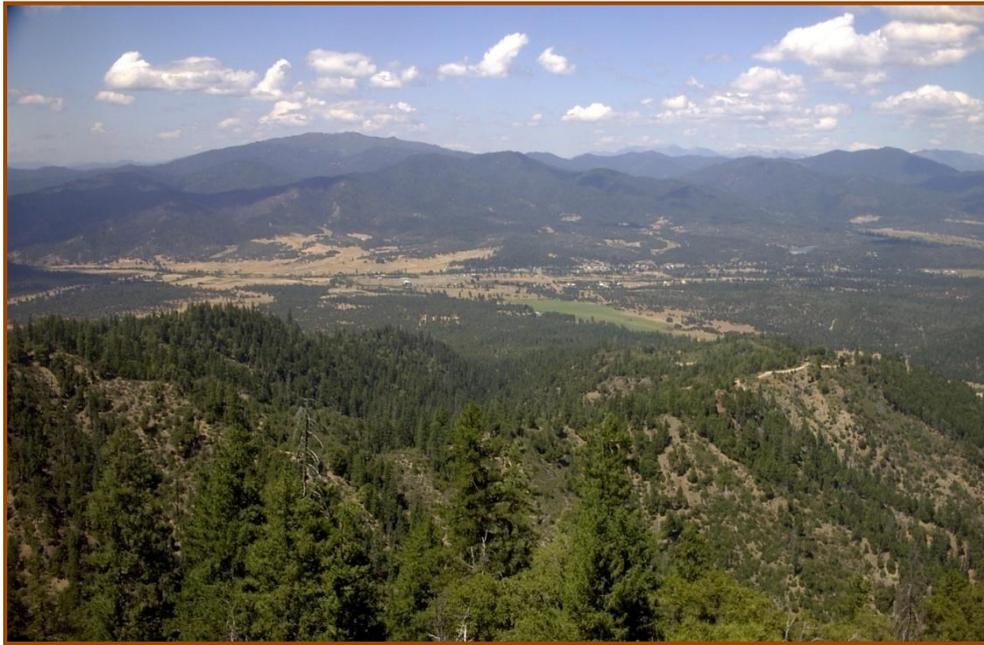


Figure 3: A view of the Hayfork Valley. Photo: WRTC.

Lightning strikes in late June of 2008 started an unprecedented wildfire season in northern California and beyond. A number of wildfires burned in the forest immediately surrounding Hayfork, and a total of 220,000 acres burned in the Shasta-Trinity National Forest (Hayfork Ranger Station 2009). The 2008 fire season was still fresh in the minds of most Hayfork-area residents when this research took place, and it will likely maintain a special position in Hayfork history—and be discussed for years to come—much as the '87 fires have.

This research recognizes that perspectives on fire management and fuels treatments, such as prescribed fire, are steeped in the extensive history of wildfire and forest management activities in the Hayfork area. It would be difficult to address

community perspectives on prescribed fire in Hayfork without first contextualizing them in the broader dialogue around fire and forest management.

Research Approach

Omnipresent fire and a rich history of community-based fire management rendered Hayfork an ideal site for this case study. Collaboration with the Watershed Research and Training Center (WRTC), the interest of innumerable Hayfork-area residents, and my position as a Hayfork community member necessitated a participatory, qualitative approach to this research.

The emphasis on qualitative methods in this research sets it apart from much of the published literature on the topic. Generally, attitudes toward prescribed fire have been gauged through quantitative research methods, usually surveys (e.g., Gardner et al. 1985, Manfredo et al. 1990, Shindler and Toman 2003, Kneeshaw et al. 2004, Brunson and Shindler 2004). Qualitative methods better suited the needs of this element of my research, as they allowed for the exploration of community perceptions through a “cyclical research path,” one where context is critical (Neuman 1994: 317). Informal qualitative research during the 2008 wildfire season proved the importance of an iterative approach, as those interactions necessitated a reframing of the research project and transformed the original research questions.

Though scarce, there are published examples of qualitative research being used to assess community perspectives on fuels treatments, including prescribed fire. Several studies have used focus group interviews to elucidate perceptions and issues surrounding fire management. Winter et al. (2002) explored perceptions of fuels treatments in diverse

regions. Rather than using surveys, the authors employed focus group interviews in each of the regions that they compared. As stated in their article, “focus groups were selected as the technique that would best help us reveal and understand...regional variances” (Winter et al. 2002: 17). Weisshaupt et al. (2007) also used focus groups in their research on homeowner perceptions of fire risk and responsibility in WUI areas of the northern Inland West. They argue that, unlike mail or other surveys, such qualitative research methods have the “potential to move beyond opinion to judgment”—they allow for the discussion and interaction necessary to understand complex issues (2007: 180).

In-depth interviews, the method I chose to use in my research in Hayfork, are also useful in complex research settings. Though in-depth interviews are less prevalent in published research than survey methods or focus groups, they offer unique benefits and opportunities. In their research on wildfire mitigation decisions among WUI residents, Brenkert et al. (2006) used an in-depth interview process with an emergent research question. In other words, though the researchers began the project with a set of semi-structured questions, they allowed space for the incorporation of new issues and themes throughout the interview process. As they argue, “this approach allowed for the emergence of themes that could not have been predicted and were not initially considered in the interview guide” (Brenkert et al. 2006: 761). This strategy is participatory, engaging research subjects in the evolution of the project. Quantitative research methods, including surveys, inherently limit the extent to which such processes can take place. Therefore, in situations where the relationships between experience, context, and

perception are of utmost interest, qualitative, participatory methods may offer the most effective approach.

Procedure and Participants

The bulk of this research consisted of in-depth, open-ended interviews with a purposeful sample of 25 Hayfork-area landowners representing 18 distinct land-ownerships. Interviewees owned land and resided in areas surrounding Hayfork. The selection process relied primarily on maximum variation sampling (Glesne 2006). With this approach, subjects representing some range of variation are selected in order to garner a rich perspective on an issue; the way(s) in which the subjects vary is specific to the research question and the research context.

In this case, interviewees came from the diverse set of backgrounds represented by Hayfork-area landowners. These groups include old-time ranching families that have resided in the Valley since early settlement; forest workers, including those who transitioned out of forest work after the SPI mill closed and those that found a way to continue alternative forest work; “back-to-the-landers,” the families and individuals that immigrated and purchased land in Hayfork during the 1970s and 80s; the Nor-El-Muk band of the Wintu, the original inhabitants and stewards of the valley; and retirees, people who have recently moved to the area in order to retire. In recent years, there has also been an influx of young families from out of the area—a group that may be considered a new wave of back-to-the-landers. Though I did not compare results among these groups, it was important for me to engage with all of them, as they represent diverse perspectives of and relationships to local landscape management.

Landowners were also chosen based on the location of their landholdings.

Sixteen of the eighteen properties included in this project were located in the interface between the town of Hayfork and the surrounding forest. Properties were located to the north, south, east, and west of Hayfork, representing almost every major residential area on the outskirts of town. Twelve of the eighteen properties were directly adjacent to both public (national forest) and private lands, one property bordered only national forest, and the other five properties, which were surrounded by private lands, were only one property away from national forest. In total, landowners included in this study represented almost 4,000 acres of landholdings in the Hayfork area.

Interviews addressed four primary themes: background in the Hayfork area; experiences with wildfire; impressions of local forest health and approaches to management; and perceptions of prescribed fire as a forest management strategy. In some cases, they were *walking* interviews, as many landowners had experience with wildfire, fire suppression, and fuels treatments and desired the opportunity to exhibit important areas. Interviews ranged from 45 minutes to 2 hours and were voice-recorded (with permission) for further reference and analysis.

Analysis

Though qualitative research is more conceptual than numerical, it often relies on the coding and quantification of important themes. Concept formation does not occur solely as a result of the researchers' experiences and discussions with participants; rather, concepts emerge from in-depth analysis of the data, which are recorded in copious notes, on tape, or both. In this case, coding was used to identify key perspectives and influences in the Hayfork community. Each interview was transcribed and general codes were established (Tables 13, 14, and 15). Additional passes through the data revealed more nuanced themes (Neuman 1994). Themes were compared by the number of interviews in which they came up and the total number of times they were discussed.

PART ONE: MANAGEMENT ACTIVITIES IN NORTHERN CALIFORNIA

Results

Seventy fire managers were asked to participate in this study (Table 2). Twenty of the twenty-two managers from the USFS returned the survey, three of whom represented two ranger districts each. Seven of the nine managers with Cal Fire returned the survey, and every manager with the BLM, NPS, FWS, and CDPR returned the survey. Two of the five tribes, three of the six NGOs, and seven of the eight timber companies also returned the survey. The overall response rate was 84%, yet the response rate of federal and state agencies was higher, at 92%.

Table 2: Response rates for prescribed fire survey by entity, northern California, 2009.

Agency	Returned/ Surveyed	Response Rate
USFS	20/22	91%
BLM	6/6	100%
Cal Fire	7/9	78%
NPS	6/6	100%
FWS	2/2	100%
CDPR	6/6	100%
Agency Total	47/51	92%
Tribes	2/5	40%
NGOs	3/6	50%
Timber Co's	7/8	88%
Overall Total	59/70	84%

Prescribed Fire Activity in Northern California

Survey respondents managed a total of 14,651,725 acres in northern California (Table 4). Of these lands, 1,488,500 acres were private, 42,000 acres were tribal, 12,867,949 acres were federal, and 253,276 acres were managed by the State.¹³ An annual average of 51,680 acres was treated with prescribed fire by all surveyed entities in the region (Table 3). Average annual burned area is based on data collected for 2006, 2007, and 2008, which revealed the treatment of 55,738 acres, 50,074 acres, and 49,227 acres, respectively (Table 3). For more detailed data on area burned (by ranger district and management area), see Appendix A.



Figure 4: Prescribed burn in the Bald Hills of Redwood National Park, September 2008.

Photo: Eamon Engber

¹³ State acres do not include lands under Cal Fire jurisdiction, as Cal Fire largely plans and implements projects on private or other lands and does not act as the primary land manager in many situations. The same is also true for several of the NGOs contacted for the survey. Therefore, estimates of total acreage covered in the study are conservative.

The US Fish and Wildlife Service reported the highest area treated with prescribed fire, with an annual average of 20,492 acres treated between 2006 and 2008 (40% of regional average) (Table 4). The US Forest Service followed with an average of 19,394 acres (38% of regional average) treated per year during the same time period. The National Park Service treated an average of 5,325 acres (10% of regional average) in those years, and Cal Fire and the Bureau of Land Management treated averages of 4,253 and 1,784 acres (8% and 4% of regional average), respectively. The California Department of Parks and Recreation maintained the lowest prescribed fire activity of the federal and state agencies surveyed, with an average of 106 acres (0.2% of regional average) treated per year between 2006 and 2008.

Prescribed fire activity was generally lower and less evenly distributed in the non-governmental sector. For example, timber companies reported treating an average of 277 acres per year with prescribed fire (0.5% of regional average), but only three of the seven companies surveyed were responsible for that activity. The two tribes that responded to the survey reported no prescribed fire activity, and only one of the three NGOs that responded reported any activity—an average of 50 acres per year between 2006 and 2008 (0.1% of regional average).

In addition to treating the most area with prescribed fire, the USFWS also treated the highest percentage of the land area under their management (Table 4); between 2006 and 2008, they treated an annual average of nearly 14 percent of the USFWS management areas included in this survey (the Modoc, Tule Lake, and Klamath National Wildlife Refuges). The NPS treated the second highest percent of land area, with an

annual average of 1.2 percent over the same time period, and two NPS areas—Redwood National Park and Lava Beds/Oregon Caves National Monument—treated annual averages of close to 6 percent of their total land areas. Every other entity included in the survey treated, on average, less than one percent of their land area with prescribed fire annually. Percent of total land area was not calculated for Cal Fire, as Cal Fire often performs fuels treatments and prescribed burning operations on private and other properties and does not typically manage specific tracts of land in the same ways that other state and federal agencies do. The same is also true for NGOs, as they often perform treatments on private properties.

Table 3: Area treated with prescribed fire (acres) by entity, northern California, 2006 to 2008.

	2006	2007	2008
USFS	19,508	17,791	20,882
BLM	850	2,329	2,172
CAL FIRE	4,246	5,771	2,741
NPS	10,610	3,622	1,743
CDPR	25	182	110
FWS	20,129	20,063	21,283
TIMBER COMPANIES	328	265	239
TRIBES	0	0	0
NGOs	42	51	57
TOTAL ALL	55,738	50,074	49,227

Respondents were also asked to list the annual area of prescribed burning needed to fulfill objectives in their management areas. The average actual area burned was then used to develop the percent burned of the area needed to fulfill management objectives. At 78 percent, Cal Fire treats the highest percentage of the annual area needed to satisfy management objectives of their prescribed fire programs. The USFWS and the NPS follow closely, treating annual averages of over 73 and 70 percent, respectively, of the area needed to fulfill management objectives of their programs. The USFS treats an annual average of 32 percent of its needed area, BLM treats almost 14 percent, and CDPR treats just under one percent. Timber companies treat just over four percent of the annual area needed to fulfill their objectives, and NGOs treat just over six percent. Data for each ranger district and management area are provided in Appendix A.

Table 4: Size of areas under management and areas treated with prescribed fire (ac.), by entity, northern California.

	Area under management (ac.)	Average area burned (ac.), 2006 to 2008	Area needed to achieve objectives (ac.)	Percent burned of managed area	Percent burned of area needed to achieve objectives
USFS	8,490,163	19,394	60,300	0.23	32.16
BLM	3,788,045	1,784	13,050	0.05	13.67
NPS	441,560	5,325	7,572	1.21	70.33
FWS	148,181	20,492	27,800	13.83	73.71
CAL FIRE	-	4,253	5,450	-	78.04
CDPR	253,276	106	13,150	0.04	0.81
TIMBER COs	1,488,500	277	6,565	0.02	4.22
TRIBES	42,000	0	0	0	0
NGOs	-	50	800	-	6.25
TOTAL ALL	14,651,725	51,680	134,687	0.04	38.37

Management Objectives for Prescribed Fire Programs

On a scale of one to ten, with one being “not important” and ten being “extremely important,” managers identified wildfire hazard reduction (average rating: 8.46), ecosystem management/restoration (7.81), and vegetation management (7.76) as the most important objectives of their prescribed fire programs. These three objectives featured the highest mean ratings of all objectives listed on the survey (Figure 5). Wildlife habitat enhancement (6.95) and cultural resources (5.12) received moderate ratings, and insect and disease management (4.88), rangeland improvement (4.44), and site preparation for reforestation (4.2) received relatively low ratings.

Figure 5: Mean ratings of management objectives for prescribed fire programs in northern California.¹⁴ Means were analyzed using a Kruskal-Wallis one-way ANOVA on ranks. Line notation denotes means that were not found to be significantly different as a result of a Kruskal-Wallis multiple comparisons z-value (Dunn’s) test using a Bonferroni z-value.

WHR	EMR	VM	WHE	CR	IDM	RI	SP
8.46	7.81	7.76	6.95	5.12	4.88	4.44	4.2

¹⁴ WHR: Wildfire Hazard Reduction; EMR: Ecosystem Management/Restoration; VM: Vegetation Management; WHE: Wildlife Habitat Enhancement; CR: Cultural Resources; IDM: Insect and Disease Management; RI: Rangeland Improvement; SP: Site Preparation for Reforestation.

Though the ratings listed above provide a general sense of the relative importance of management objectives in the region, responses did vary by entity (Table 5). The pattern of ratings by USFS managers closely resembled that of the overall group, with wildfire hazard reduction, ecosystem management/restoration, and vegetation management identified as top objectives. Managers with Cal Fire similarly identified wildfire hazard reduction and vegetation management as two of their most important objectives, yet rangeland improvement was also identified as a top objective. For most other entities, rangeland improvement was of little importance. Wildfire hazard reduction was also the top objective of timber companies, though site preparation for reforestation followed closely. In contrast with most other groups, timber companies identified ecosystem management/restoration and wildlife habitat enhancement as two of their least important objectives.

Ecosystem management/restoration was identified as the most important management objective by managers with both the NPS and CDPR. Wildfire hazard reduction remained important for these two groups, with the third highest rating in both cases. In contrast, the FWS rated wildfire hazard reduction as one of their least important objectives, with wildlife habitat enhancement, vegetation management, and ecosystem management/restoration paramount. Tribes were also notable for their distinct management objectives. Though there was great variability in the responses of the two participating tribes (see standard deviation values below average ratings), cultural resources and site preparation for reforestation were identified – with little to no variation – as most their two most important objectives.

Table 5: Mean ratings (with standard deviations) of management objectives for prescribed burning programs, by entity, northern California. (Scale of 1-10, with 1 being “not important” and 10 being “very important.”) Superscript differences denote significant differences in means across entities for specific objectives (result of Tukey-Kramer multiple comparisons test). (* $p < 0.05$)

Management Objective	All N=59	USFS N=20	BLM N=6	Cal Fire N=7	NPS N=6	CDPR N=6	FWS N=2	TC N=7	Tribes N=2	NGOs N=3	<i>P-value</i>
Wildfire Hazard Reduction	8.46 (2.11)	8.95 (1.15)	9.33 (.82)	9.29 (1.5)	7.83 (2.79)	6.83 (1.17)	3.0 (1.41)	9.14 (1.22)	5.5 (6.36)	10.0 (.00)	<0.000*
Ecosystem Management/Restoration	7.81 (2.18)	8.15 ^b (1.43)	8.83 ^b (1.17)	6.14 ^a (2.61)	9.5 ^b (1.23)	8.67 ^{ab} (1.21)	8.0 ^{ab} (2.83)	5.43 ^a (1.72)	5.5 ^{ab} (6.36)	9.3 ^{ab} (.58)	.001*
Vegetation Management	7.76 (2.07)	8.0 ^{ab} (1.69)	6.5 ^{ab} (1.87)	9.3 ^a (1.11)	8.83 ^{ab} (1.33)	6.67 ^{ab} (2.66)	8.5 ^{ab} (2.12)	7.14 ^{ab} (2.04)	4.0 ^b (4.24)	8.67 ^{ab} (1.16)	0.01*
Wildlife Habitat Enhancement	6.95 (2.15)	7.2 (1.4)	8.0 (1.27)	6.14 (2.97)	6.5 (2.81)	7.33 (1.21)	10.0 (.00)	5.29 (1.98)	4.5 (4.95)	8.67 (1.16)	0.03*
Cultural Resources	5.12 (3.17)	5.45 (2.82)	5.0 (2.19)	6.29 (2.43)	5.67 (3.83)	3.67 (2.88)	1.0 (.00)	2.86 (3.29)	9.5 (.71)	7.33 (4.62)	0.048*
Insect and Disease Management	4.88 (2.79)	5.35 (2.08)	4.17 (2.56)	5.57 (3.6)	5.17 (2.79)	3.17 (2.79)	2.5 (.71)	4.71 (3.25)	5.5 (6.36)	6.0 (4.0)	0.69
Rangeland Improvement	4.44 (3.03)	4.05 ^{ab} (2.42)	5.5 ^{ab} (3.15)	7.29 ^a (2.81)	2.5 ^{ab} (3.21)	2.0 ^b (2.0)	6.5 ^{ab} (4.95)	4.71 ^{ab} (2.69)	3.0 ^{ab} (2.83)	6.0 ^{ab} (4.0)	0.03*
Site Preparation for Reforestation	4.2 (3.11)	5.4 ^{bd} (2.84)	2.83 ^{ad} (1.84)	3.0 ^{acd} (2.45)	1.83 ^a (2.04)	1.33 ^a (.52)	1.0 ^{ad} (.00)	7.71 ^b (2.36)	9.0 ^{bc} (.00)	3.0 ^{abc} (2.0)	<0.000*

As indicated in Table 5, ratings differed significantly among entities for all management objectives except insect and disease management. To see where entities differed significantly (results of Tukey-Kramer multiple comparisons tests), see superscript notations in Table 5.

Impediments to the Use of Prescribed Fire – Which Are Most Limiting?

On a scale of one to ten, with one being “not limiting” and ten being “extremely limiting,” managers demonstrated the relative impact of a range of constraints on their prescribed fire programs. Of the thirteen impediments listed on the survey, managers identified narrow burn window (average rating: 8.2) and regulations (7.2) as the biggest limitations on their abilities to use prescribed fire. Ratings of these two impediments were significantly higher than the ratings of all others (Figure 6). Lack of adequate personnel (6.19) and environmental laws¹⁵ (6.12) were also identified as top constraints on prescribed fire activity in northern California. Other impediments included, in order of descending importance, residential areas near burn (5.98), lack of adequate funding (5.62), liability (5.48), fuel loading (5.44), planning costs (4.93), public opinion (4.59), preference for alternative strategies (4.28), burn unit preparation (4.18), and insurance limitations (3.48).

¹⁵ This category covers a range of laws, including the Clean Water Act of 1977, the Endangered Species Act of 1973, the National Forest Management Act of 1976, and the National Environmental Policy Act of 1970, but it does not include air quality restrictions (they are covered on the survey under regulations).

Table 6: Number of responses in each rating category for given impediments. (Scale of 1 to 10 with one being “not limiting” and 10 being “extremely limiting”). N=59.¹⁶

Impediment	Not Limiting (rating of 1-4)	Neutral (rating of 5-6)	Limiting (rating of 7-10)
Public Opinion	34	11	13
Residential Areas Near Burn	21	11	27
Planning Costs	25	15	17
Burn Unit Preparation	33	14	9
Lack of Funding	22	10	26
Regulations	11	7	41
Environmental Laws	16	14	28
Liability	25	9	24
Insurance Limitations	41	5	10
Lack of Adequate Personnel	15	13	30
Narrow Burn Window	2	3	54
Fuel Loading	19	20	20
Preference for Alternative Strategies	33	11	12

¹⁶ Due to missing (not reported) values, some impediments did not have a total of 59 responses.

Figure 6: Mean ratings for impediments to prescribed fire programs in northern California.¹⁷ Means were analyzed using a Kruskal-Wallis one-way ANOVA on ranks. Line notation denotes means that were not found to be significantly different as a result of a Kruskal-Wallis multiple comparisons z-value (Dunn's) test using a Bonferroni z-value.

NBW	RG	LAP	EL	RA	LAF	LI	FL	PC	PO	PAS	BUP	IL
8.2	7.2	6.19	6.12	5.98	5.62	5.48	5.44	4.93	4.59	4.28	4.18	3.48

Impediments – Differences Between Entities

For four of the 13 impediments, one-way analyses of variance (ANOVA) showed significant differences in mean ratings among individual entities. These impediments included environmental laws ($p = 0.005$), lack of adequate funding ($p = 0.004$), liability ($p = 0.04$), and insurance limitations ($p < 0.001$). To see where entities differed significantly (results of Tukey-Kramer multiple comparisons tests), see superscript notation in Table 7.

¹⁷ NBW: Narrow Burn Window; RG: Regulations; LAP: Lack of Adequate Personnel; EL: Environmental Laws; RA: Residential Areas Near Burn; LAF: Lack of Adequate Funding; LI: Liability; FL: Fuel Loading; PC: Planning Costs; PO: Public Opinion; PAS: Preference for Alternative Strategies; BUP: Burn Unit Preparation; IL: Insurance Limitations.

Table 7: Mean ratings (with standard deviations) of impediments to prescribed fire by entity, northern California. (Scale of 1-10, with 1 being “not limiting” and 10 being “extremely limiting.”) Superscript letters denote significant differences in means across entities for specific impediments (result of Tukey-Kramer multiple comparisons test). (* $p < 0.05$)

Impediment	All N=59	USFS N=20	BLM N=6	NPS N=6	FWS N=2	CDPR N=6	Cal Fire N=7	TC N=7	Tribes N=2	NGOs N=3	<i>P-value</i>
Narrow Burn Window	8.2 (1.71)	8.15 (1.09)	6.67 (3.33)	8.67 (1.03)	7.5 (3.54)	8.0 (2.0)	9.29 (0.95)	8.71 (1.25)	9.0 (0)	7.33 (2.08)	0.24
Regulations	7.2 (2.66)	6.55 (3.09)	6.33 (2.94)	7.0 (2.97)	6.5 (0.71)	7.17 (1.17)	8.0 (2.0)	9.57 (0.79)	9.0 (1.41)	5.67 (4.04)	0.25
Lack of Adequate Personnel	6.19 (2.74)	5.6 (2.74)	4.83 (3.71)	6.17 (2.64)	9.0 (1.41)	7.83 (2.99)	6.71 (2.43)	5.83 (2.32)	6.5 (3.54)	7.0 (1.73)	0.53
Environmental Laws	6.12 (2.65)	6.7 ^{ab} (2.13)	4.83 ^{ab} (2.32)	3.67 ^a (1.97)	4.0 ^{ab} (1.41)	5.17 ^{ab} (3.43)	7.71 ^{ab} (1.7)	8.67 ^b (2.07)	6.5 ^{ab} (4.95)	4.0 ^{ab} (1.73)	0.005*
Residential Area Near Burn	5.98 (3.08)	5.45 (3.19)	6.67 (3.08)	5.83 (3.19)	3.5 (2.12)	6.17 (3.06)	8.14 (2.12)	6.86 (3.02)	2.0 (1.41)	5.33 (4.04)	0.29
Lack of Adequate Funding	5.62 (3.03)	4.65 ^{ab} (3.05)	4.0 ^{ab} (2.0)	3.0 ^a (2.19)	7.0 ^{ab} (2.83)	8.0 ^b (3.16)	7.71 ^{ab} (1.89)	5.5 ^{ab} (2.66)	9.0 ^{ab} (1.41)	8.0 ^{ab} (1.0)	0.004*
Liability	5.48 (3.05)	4.85 (2.66)	4.5 (2.88)	4.2 (3.56)	3.5 (2.12)	4.0 (3.1)	6.86 (2.55)	8.86 (1.46)	6.5 (4.95)	6.33 (4.04)	0.04*
Fuel Loading	5.44 (2.57)	6.1 (2.55)	4.0 (1.67)	5.5 (1.38)	2.0 (1.41)	5.0 (3.35)	6.0 (2.65)	6.14 (3.13)	5.0 (2.83)	4.33 (2.52)	0.40

Impediment (continued)	All N=59	USFS N=20	BLM N=6	NPS N=6	FWS N=2	CDPR N=6	Cal Fire N=7	TC N=7	Tribes N=2	NGOs N=3	<i>P-value</i>
Planning Costs	4.93 (2.83)	4.75 (2.75)	3.0 (1.67)	3.5 (1.52)	4.0 (2.83)	7.33 (3.33)	6.0 (2.53)	5.17 (3.31)	7.0 (2.83)	4.67 (4.04)	0.19
Public Opinion	4.59 (2.53)	4.1 (2.45)	3.67 (1.51)	4.0 (2.61)	4.0 (1.41)	3.5 (1.87)	5.71 (2.29)	7.0 (2.68)	5.5 (6.36)	5.33 (2.31)	0.23
Preference for Alternative Strategies	4.28 (2.57)	4.84 (2.61)	4.67 (2.07)	2.33 (1.03)	3.5 (2.12)	4.5 (3.78)	4.86 (3.29)	3.33 (1.86)	5.0 (2.83)	4.0 (2.65)	0.66
Burn Unit Preparation	4.18 (2.46)	3.78 (2.49)	3.83 (1.33)	3.67 (2.5)	5.0 (1.41)	5.5 (2.81)	5.29 (2.87)	4.5 (2.95)	3.0 (2.83)	2.67 (2.08)	0.68
Insurance Limitations	3.48 (2.81)	2.84 ^a (1.86)	2.0 ^a (0.89)	2.0 ^a (1.73)	1.5 ^{ab} (0.71)	1.2 ^a (0.45)	4.86 ^{ab} (2.91)	6.71 ^b (3.68)	5.0 ^{ab} (2.83)	6.33 ^{ab} (4.04)	<0.001*

Impediments – Differences Between Federal, State, and Private Entities

Significant differences were found between federal (N = 34), state (N = 13), and private (N = 12) entities for four of the 13 impediments. These impediments included lack of adequate funding ($p < 0.001$), liability ($p = 0.005$), planning costs ($p = 0.02$), public opinion ($p = 0.03$), and insurance limitations ($p < 0.001$). To see where federal, state, and private entities differed (result of Tukey-Kramer multiple comparisons tests), see superscript notation in Table 8.

Table 8: Ratings of impediments to prescribed fire by federal, state, and private entities in northern California, 2009. (* $p < 0.05$)

Impediment	Federal (N = 34)	State (N = 13)	Private (N = 12)	<i>P-value</i>
Narrow Burn Window	7.94	8.69	8.42	0.37
Regulations	6.59	7.62	8.5	0.08
Lack of Adequate Personnel	5.76	7.23	6.27	0.26
Environmental Laws	5.68	6.54	7.0	0.29
Residential Areas Near Burn	5.6	7.23	5.67	0.26
Lack of Adequate Funding	4.38 ^a	7.85 ^b	6.82 ^b	<0.001*
Liability	4.61 ^a	5.54 ^{ab}	7.83 ^b	0.005*
Fuel Loading	5.38	5.54	5.5	0.98
Planning Costs	4.18 ^a	6.67 ^b	5.36 ^{ab}	0.02*
Public Opinion	4.0 ^a	4.69 ^{ab}	6.27 ^b	0.03*
Preference for Alternative Strategies	4.27	4.69	3.82	0.72
Burn Unit Preparation	3.84	5.39	3.73	0.13
Insurance Limitations	2.47 ^a	3.33 ^a	6.33 ^b	<0.001*

Impediments – Differences Between Public and Private Lands Managers

For six of the 13 impediments, there were significant differences between the mean ratings given by public (N = 40) and private (N = 19) lands managers (Table 9). These impediments included regulations ($p = 0.02$), environmental laws ($p = 0.029$), lack of adequate funding ($p = 0.004$), liability ($p < 0.001$), public opinion ($p = 0.007$), and insurance limitations ($p < 0.001$).

Table 9: Mean ratings of impediments to prescribed fire by public and private lands managers in northern California, 2009. (* $p < 0.05$)

Impediment	Public Lands (N = 40)	Private Lands (N = 19)	<i>P-value</i>
Narrow Burn Window	7.95	8.74	0.07
Regulations	6.68	8.32	0.02*
Lack of Adequate Personnel	6.08	6.44	0.60
Environmental Laws	5.6	7.28	0.029*
Residential Areas Near Burn	5.7	6.58	0.32
Lack of Adequate Funding	4.93	7.17	0.004*
Liability	4.51	7.47	< 0.001*
Fuel Loading	5.33	5.68	0.63
Planning Costs	4.65	5.59	0.27
Public Opinion	3.92	6.06	0.007*
Preference for Alternative Strategies	4.31	4.22	0.91
Burn Unit Preparation	4.11	4.33	0.76
Insurance Limitations	2.3	5.79	< 0.001*

Impediments – Differences Between NW and NE California

For two of the 13 impediments, there were significant differences between the mean ratings given by managers in northwestern (N = 36) and northeastern (N = 22) California. These impediments included lack of adequate funding (NW CA, mean rating of 6.47; NE CA, 4.23; $p = 0.005$) and planning costs (NW CA, 5.6; NE CA, 3.86; $p = .018$).

Satisfaction with Programs and Perceptions of Risk

Respondents rated their levels of agreement with several statements (Table 10). These statements attempted to gauge managers' levels of satisfaction with burning programs and managers' perceptions of risk.

The majority of managers that participated in this study disagreed with the following statement: "I am generally satisfied with the amount of prescribed burning achieved in my management area each year." Seventy-six percent of the managers that responded to this statement gave it a rating of four or less, indicating disagreement, and 39 percent of those gave it a rating of 2 or less, indicating strong disagreement. Those results were supported by widespread agreement with the following statement: "I wish that we could treat more acres in our management area with prescribed fire." Ninety-five percent of the managers that responded to this statement gave it a rating of seven or more, indicating agreement, and 61 percent of those gave it a rating of 9 or more, indicating strong agreement.

Table 10: Number of responses in each rating category for given statements, northern California prescribed fire survey, 2009. (Scale of 1 to 10 with 1 being “strongly disagree” and 10 being “strongly agree.”) N=59.¹⁸

	1-2 Strongly disagree	3-4	5-6	7-8	9-10 Strongly agree
“I am generally satisfied with the amount of prescribed burning achieved in my management area each year.”	17	27	5	9	0
“I wish that we could treat more acres in our management area with prescribed fire.”	0	0	3	22	34
“Managers must take personal risks in order to get prescribed fire on the ground.”	6	9	5	19	19
“I am willing to take personal risks in order to use prescribed fire in my management area.”	6	14	6	23	9

A majority of managers agreed with the following statement: “Managers must take personal risks in order to get prescribed fire on the ground.” Sixty-six percent of the managers that responded to this statement gave it a rating of seven or more, indicating agreement, and 50 percent of those gave it a rating of nine or more, indicating strong agreement. Twenty-six percent of respondents disagreed with the statement, giving it a rating of four or less, and nine percent were neutral, giving it a rating of five or six. Responses to the last statement – “I am willing to take personal risks in order to use prescribed fire in my management area” – were more varied than responses to the previous statements. Fifty-five percent of respondents agreed with the statement (giving

¹⁸ Due to missing (not reported) values, the first, third, and fourth statements have only 58 responses.

it a rating of seven or more), 35 percent disagreed (rating of four or less), and 10 percent of respondents were neutral (rating of five or six). There were no significant differences in the mean ratings of these four statements between individual entities, public and private lands managers, managers in northwestern and northeastern California, or federal, state, and private managers.

Discussion

Prescribed fire is an important resource management tool in northern California and beyond. If defined loosely, prescribed burning may be considered one of the most widespread planned disturbances in this country's forests, even ahead of timber harvesting (Cleaves et al. 2000). Research has demonstrated a shared need by land managers to increase the use of prescribed fire, yet the expansion of prescribed fire programs has met with increasing difficulty over the years (Cleaves et al. 2000). While a host of similar constraints face burning programs nationwide, the impact of specific constraints appears to vary by context.

Prescribed Fire Activity in Northern California

Based on data for 2006 to 2008, managers in northern California treat an average of 51,680 acres with prescribed fire each year. As noted previously, prescribed fire, for the purposes of this study, includes only management-ignited broadcast burns and excludes areas treated with slash burns, wildland fire, or other related methods. Though such methods are important management tools, their inclusion would have diluted this study's focus on impediments to the use of management-ignited, landscape-level burns. Previous studies have employed a broader definition of prescribed fire, including slash burning and management-ignited under-burning in one case (Haines et al. 2001) and slash reduction, management-ignited under-burns, prescribed natural fire, and

brush/range/grassland burns in another (Cleaves et al. 2000). Somewhat detailed reporting in the aforementioned studies allowed for comparisons (Table 11).

The southeastern United States consistently treats more acres with prescribed fire than any other region in the country (Table 11). Research for 1985-1994 showed that the USFS Southern Region (Region 8) was responsible for almost 50% of national USFS prescribed fire activity, treating an annual average of 434,119 acres (Cleaves et al. 2000). Of those acres, 407,005 were treated with management-ignited broadcast burns (in forest or brush/range/grassland).

Other areas of the country – including northern California – treat substantially less area with prescribed fire. For example, the 51,680 acres treated annually in northern California represent only 0.04 percent of the total managed area included in the study, in contrast to the 3.2 percent of managed area treated in USFS Region 8. Yet individual agencies in northern California do compete with activity in the south; for instance, US Fish and Wildlife Service prescribed fire programs succeed in treating an average of 13.83 percent of their managed area each year, and the National Park Service treats 1.21 percent. Other entities, including state and federal agencies, tribes, timber companies, and NGOs, treat less than one percent of their management areas with prescribed fire each year.

Table 11: Prescribed fire activity in the United States, as documented in this research and past studies.

Entity/region	Total size of management area (ac.)	Area treated with Rx fire (ac) ¹⁹	Area treated only with mngt-ignited Rx fire (ac) ²⁰	Percent of managed area treated with Rx fire ¹⁹	Percent of managed area treated with mngt-ignited Rx fire ²⁰
<i>Cleaves et al. 2000:</i>					
USFS/Region 1	24,114,082	77,186	13,196	0.3	0.06
USFS/Region 2	19,867,400	11,867	8,897	0.1	0.05
USFS/Region 3	20,336,799	184,248	131,039	0.9	0.6
USFS/Region 4	31,800,548	15,412	9,216	0.05	0.03
USFS/Region 5	19,989,439	54,401	23,464	0.3	0.1
USFS/Region 6	24,507,926	114,674	35,340	0.5	0.1
USFS/Region 8	12,655,924	434,119	407,005	3.4	3.2
USFS/Region 9	11,793,585	16,213	12,014	0.1	0.1
<i>Haines et al. 2001:</i>					
Southern states ²¹		4,100,000			
USFS/S. states		492,000	462,480		
State & private/S. states		3,608,000	2,597,760		
<i>National Interagency Fire Center 2009:</i>					
All agencies/U.S.		2,187,642			
<i>This research (2009):</i>					
All entities/N. California	14,651,725		51,680		0.04
USFS/N. CA	8,490,163		19,394		0.23
FWS/N. CA	148,181		20,492		13.83
NPS/N. CA	441,560		5,325		1.21
BLM/N. CA	3,788,045		1,784		0.05
Cal Fire/N. CA			4,253		
CDPR/N. CA	253,276		106		0.04
Tribes/N. CA ²²	42,000		0		0
Private/N. CA ²²	1,488,500		327		0.02

¹⁹ Using a broad definition of prescribed fire, including slash burns, WFU fires, etc., in addition to management-ignited burns.

²⁰ Using a more conservative definition of prescribed fire, including only management-ignited forest, range, and grassland broadcast burns.

²¹ States included Alabama, Florida, Georgia, South Carolina, Louisiana, Mississippi, North Carolina, Texas, Arkansas, Oklahoma, and Virginia.

²² Only a sub-sample of tribes and private (timber companies and NGOs) entities were surveyed; therefore, data sets are not complete for these groups.

Unfortunately, national research on prescribed fire activity has been somewhat limited, focusing primarily on USFS activity (Cleaves et al. 2000) and, in one case, on both the USFS and state/private entities (Haines et al. 2001). The online National Interagency Fire Center (2009) appears to be a primary source of interagency data on prescribed fire, yet the site reports national totals and does not offer a geographic breakdown of data. Thus, it is difficult to contextualize and compare data collected in this research from agencies other than the USFS, such as the FWS, NPS, BLM, Cal Fire, and CDPR.

The impressive activity reported by the FWS in northern California may be explained in part by the ecosystems that FWS manages with fire. Many of the areas that they burn are grasslands, requiring less pre-treatment than forests and allowing for larger burn units. Upon hearing that the FWS burns the most acres of anyone in northern California, it was not uncommon for managers from other agencies to say “that’s not fair – they’re just burning grass!” Yet the regional Fire Management Officer with the FWS argued on his survey that the FWS has the “busiest prescribed fire program in California, and perhaps on the West Coast.” With an average of 20,492 acres treated every year, his point is hard to dispute.

Management Objectives in Prescribed Fire Programs

As mentioned previously, this research in northern California stands out because of its multi-agency approach. At least one other study has likewise considered multiple entities in a given region – the USFS and state/private (Haines et al. 2001) – but most have focused solely on the USFS (e.g., Cleaves et al. 2000, Williamson 2007, Black et al.

2008). The inclusion of multiple entities in this research allows for the comparison of management objectives across a range of groups; objectives for prescribed fire are, in large part, tied to the overarching land management goals of each given entity.

Past research demonstrated a difference in the management objectives of USFS and state/private prescribed fire programs in the southeastern United States (Haines et al. 2001). Though the two groups shared wildfire hazard reduction as a primary objective, the two groups' other top objectives contrasted. USFS objectives focused on habitat improvement and ecosystem management, whereas state/private entities highlighted reforestation, vegetation control in established stands, and habitat improvement for game birds and animals. USFS objectives tended to emphasize resource conservation, and state/private objectives tended to focus on resource improvement and use.

Similar patterns to those found in the southeastern United States arose in results for northern California. Almost all entities identified wildfire hazard reduction as a primary objective of their prescribed fire programs (excluding the FWS), yet other top objectives tended to speak directly to the particular organizational goals of each entity. For instance, the FWS identified wildlife habitat enhancement as their top objective, the NPS and CDPR identified ecosystem management/restoration as their top objective, Cal Fire selected vegetation management (tribute to their Vegetation Management Program, responsible for much of their prescribed burning), timber companies selected site preparation for reforestation and vegetation management, and tribes identified cultural resources as their top objective. Thus, management objectives for prescribed fire programs are clearly a product of each entity's larger land management goals.

Impediments to the Use of Prescribed Fire

Survey results indicated a general dissatisfaction among managers with the amount of prescribed burning achieved in their management areas each year. Such dissatisfaction stemmed from a desire to treat more area with prescribed fire and the sense that there were significant barriers standing in the way of program expansions across agencies.

Prescribed fire in northern California is severely limited by both operational and regulatory issues. Operational concerns, including narrow burn window and lack of adequate personnel, were identified as two of the three most important constraints on prescribed fire activity in the region. Narrow burn window clearly stood out as the most important constraint, earning the highest rating (with the lowest standard deviation) of all impediments listed on the survey.

Though narrow burn window has been identified as an important constraint in previous research, its status as the top impediment appears to be unique to this region. In their research on USFS prescribed fire programs across the country, Cleaves et al. identified narrow burn window as the third most important constraint, following regulations and lack of funding (2000). In Region 5 (California) specifically, narrow burn window was identified as the sixth most important constraint (Cleaves et al. 2000). Research by Haines et al. (2001) also found narrow burn window to be of moderate importance in the South; it was identified as the fourth most important constraint for USFS programs in that region and the sixth most important constraint for state/private entities.

The importance of narrow burn window in northern California reflects the unique relationship between the weather patterns, topography, and regulations present in the region. With its Mediterranean climate, northern California experiences limited time frames in which prescribed fire would be either possible (long wet winters make burning difficult in many areas) or safe (hot, dry summers make spring and summer burning more risky). Appropriate conditions tend to fall between the two extremes, when the weather is mild enough to permit burning but fuels are still dry enough to render burns effective. For example, burning in Redwood National Park was severely impacted by lack of sufficient burn windows during fall 2009. Though the park successfully implemented several burns, many well-prepared burn units were not treated due to inappropriate weather; burns were cancelled on several instances because conditions – such as relative humidity and wind speed – exceeded the prescription. Just days after those cancellations, a Pacific storm blew in, drenching burn units to the point where many oak woodland areas were too wet to burn. Needless to say, narrow burn window is cause for much frustration in Redwood National Park and the management community in general (pers. Comm. John McClelland 2009).

Though burn window is related primarily to weather, it is the social and political context within which weather is framed that defines acceptable “windows” of opportunity. Regulations play a large part in defining acceptable weather, and they are therefore an instrumental component of burn windows. Regulations dictate acceptable air quality conditions, relative humidity levels, wind speeds, and more. Thus, it is not surprising that regulations were identified as the second most important constraint on

prescribed fire activity in northern California. As noted previously, regulations have been shown to be the top constraint to USFS programs in the South (Haines et al. 2001) and nationally (Cleaves et al. 2000).

Although the importance of several constraints – such as narrow burn window and regulations – was shared by most entities included in this research, there was some variation in responses across groups. Differences in responses of individual entities; federal, state, and private entities; managers in northwestern and northeastern California; and public and private lands managers were analyzed, and significant differences were found in all cases.

Three major themes emerged from analyses of impediment ratings: legal impediments are more of a concern in the private sector than in the public, economic impediments are more of a concern in the state and private sectors than in the federal, and public opinion is more of a concern in the private sector than in the public.

Private entities consistently rated legal impediments, such as environmental laws, regulations, liability, and insurance limitations, significantly higher than public entities. Most of these differences were evident in analyses of differences between individual entities and between federal, state, and private entities, but they were most evident in analyses of differences between public and private lands managers, wherein Cal Fire was included as a private lands manager.²³ This analysis illuminated the consistency with which Cal Fire responses paralleled those in the private sector and contrasted with those in the public sector, even though Cal Fire is a public agency.

²³ As stated in the methods, Cal Fire was included as a private lands manager because most of their prescribed burning occurs on either private lands or other lands not under management by the agency.

Economic impediments, such as planning costs and lack of adequate funding, were identified as much more of a constraint in the state and private sectors than in the federal. This is not surprising, given the current economic downturn in the state of California.

A constraint of particular interest in this research was public opinion, as it is a primary link between this survey of fire managers in northern California and the associated case study of public opinion in Hayfork. In concert with findings by Haines et al. (2001), there were notable differences in ratings of public opinion between those that manage private lands and those that manage public lands. Private lands managers consistently gave public opinion significantly higher ratings than public lands managers did, indicating that the groups managing public lands are less concerned with – or perhaps feel less limited by – public opinion than the groups managing private lands. The contradiction here is clear; why are private lands managers more concerned with public opinion, when public lands managers are charged with upholding public interest and private lands managers are not? The issue of public opinion will be revisited in the case study of community support in Hayfork and in the conclusion.

PART TWO: COMMUNITY SUPPORT FOR PRESCRIBED FIRE

Results

This study included interviews with 25 Hayfork-area landowners representing eighteen distinct land-ownerships and almost 4,000 acres (Table 12). Landholdings ranged in size from four and a half acres to over 1,000 acres. Of the eighteen properties, 12 bordered both national forest (NF) and private (PR) lands, one bordered only national forest, and five bordered only private lands. Residency times of landowners ranged from just two years to over 80, with three landowners residing in the Hayfork area for their entire lives.

Table 12: Characteristics of landowners and properties participating in a case study of perspectives on fire management, Hayfork, CA, 2009.

Landowner	Acreage	Years in Hayfork area	Bordering properties ²⁴
1	120	29	NF
2	107	10	NF/PR
3	10	~35 (whole life)	NF/PR
4	40	26	PR
5	160	40	NF/PR
6	10	34	PR
7	50	9	NF/PR
8	160	34	NF/PR
9	160	30	NF/PR
10	4.5	2	PR
11	1,000	38	NF/PR
12	223.5	~70 (whole life)	NF/PR
13	30	3	NF/PR
14	100	5	PR
15	240	38	NF/PR
16	1,000	~80 (whole life)	NF/PR
17	80	36	NF/PR
18	50	41	PR

²⁴ Bordering properties were NF = National Forest, PR = Private, NF/PR = National Forest and Private.

Though perceptions of fire management in Hayfork are complex and varied, there are a number of areas where perspectives overlap. These areas emerged as prominent themes in the interview process.

Fundamental to the fire discourse in Hayfork is the idea that fire is a natural component of local ecosystems. This theme emerged in 78 percent of interviews and was mentioned a total of 37 times (hereafter “78%, 37”) (Table 13). Considering this shared belief, it is not surprising that a number of landowners blamed fire suppression for the poor health and elevated fire hazard in local forests (50%, 13). The connection between logging activities and poor forest conditions was also noted by many (56%, 21).

The need for year-round management of local forests was also a major theme, emerging in 72 percent of interviews and a total of 23 times (Table 14). Landowners recognized their role in fire management, frequently alluding to the responsibilities of private landowners in mitigating fire hazard (56%, 27). The need for local control of forest and fire management and the integration of local knowledge also came up often (56%, 22).

Landowners envisioned both prescribed fire and thinning activities as important elements of successful fire management (Table 14). Support for prescribed fire was surprisingly strong (67%, 35), and five of the properties included in the study are currently managed to some extent with landowner-ignited prescribed burns. Support for thinning activities was also high (72%, 25), and it is a management activity which many landowners have employed.

Though there is support for both prescribed fire and thinning activities, it appears to hinge on the relationship between land managers and the community. Many landowners strongly supported the concept of prescribed fire, yet their concern for who would manage projects often rendered support conditional (50%, 11) (Table 15). There is a widespread distrust of federal land managers, namely the USFS (61%, 25). The idea that the USFS is incompetent was one of the most mentioned themes in the interviews (56%, 39), connected with, but not limited to, experiences during the 2008 fire season. Though many like and appreciate local USFS staff (33%, 7), there is shared concern over the top-down management of the agency and a lack of local authority.

The Role of Fire

As discussed previously, many landowners acknowledged that fire is a natural process in local forests. Many used historical conditions as proof of the natural role of fire in the area, arguing that hazard has increased with the exclusion of fire.

*EM:*²⁵ Historically, it seems like the Indians and the lightning pretty much controlled the forest and took care of it in a natural way and as civilization came along we stopped that and got ourselves now in a pickle.

KR: [Historically], there was a lot of fire, but the fire didn't get rampaging like it does now because there wasn't that much fuel on the ground, and you go out and you look at Indian Valley and Butter Creek and all these places, you don't have to be a rocket scientist to see all the fire scars on the trees and all the big cedars have cat faces on them. The history of fire is there.

Many landowners also spoke of the benefits of fire in local forests. For these landowners, fire is both natural and essential.

²⁵ Landowner initials have been changed for confidentiality purposes.

HR: I think fire is really important for a healthy forest. I think we don't understand...I think it has an impact on disease control, I think it has an impact on soil.

ED: [Fire] burns the grass back. And that's part of nature. And then it opens up, kills the canopy, the lower canopy, and allows the grasses to grow and allows everything to go through the natural cycle.

NT: I think fire is a powerful and cleansing thing.

KB: In these forests, the only way that phosphorus and nitrogen get cycled is by fire, and if you exclude fire over a long period of time, the trees will be weak and won't have the nutrients they need.

For others, the role of fire was less clear. Much of the confusion around the role of fire appears related to confusion around the role of humans in managing fire.

IG: I'm still trying to wrap my head around all of this...I met this Cal Trans guy when I was stopped during the fires and he was like "if the hippies would just let us burn, we wouldn't have all these problems." And I was like "okay..." I'm still just trying to understand. So if you burn it, then it won't burn. Or logging it, if they log it, maybe it won't burn. But I do believe that fires are something that have to happen. It's the earth's way, part of the balance of nature, I do believe that. I don't know how much of that is humans being involved directly or how much they're harming that. It's tricky.

EM: How do we proceed with forest fire...is difficult because now when a fire comes with so much brush and wood, it can be a conflagration rather than an understory burn. And so how we deal with it is why there's been so much discussion and discord because nobody can really, in many areas, come to a conclusion that's satisfactory to everyone...So what's the answer..? If I had the answer, we would have saved a lot of bullshit and government money, but I don't have the answer.

Though many landowners agreed that fire was either natural or beneficial, feelings about wildfire and let-burn policies were varied. The following quotes illustrate approval of let-burn policies (28%, 9):

HR: I think that, if you're talking about burns, they should take place when the normal cycle would have been burning. [During the fires last summer], I remember people getting mad at me 'cause I was saying just sit back and enjoy it...this is a perfect time for a fire. Just let it go.

NT: So I don't know a permanent solution, but I think you've got to let it burn, I mean, it's the wisdom of the forest, it's kept it healthy for millions of years and that seems to be the major problem is just the suppression of it.

KR: I think if they're not going to log it, [let-burn] is great. I don't see any point in spending billions of dollars putting out fires to save timber that nobody's going to use. I've got a suspicion that there are a lot of other people that feel that way, too, that's why they're letting it burn. Because it will clean it up and in the long-term, it will make for fewer or less instances where you will have fire storms.

Others did not support let-burn policies (33%, 10):

MJ: I don't think you need to let-burn, especially when the forests are so incredibly dry. I think anyone who wants to let it burn is asking for problems. We're in a drought. Put it out. You have the opportunity to put it out, put it out.

NR: But the thing is, I've noticed with [wildfire], it leaves fuels. It isn't like it gets rid of all the understory. The understory is still standing there with all the dead leaves and dead wood and it seems to me like it's a fire hazard when that happens as much as if not more than it was before. So I don't understand how that's really a good thing.

TS: You've got one hundred years of accumulations, so to think that you could mimic the situations that Native Americans and ranchers did in the fall by letting a fire burn uncontrolled in the middle of the summer is not a difference of opinion, it's ludicrous. They're idiots.

For many, whether they support let-burn policies or not, management-ignited fire is preferable to naturally-ignited fire.

ED: Yeah, let it burn, but in November and January and Feb and March.

NT: [I support] mimicking what would happen naturally but in a much more controlled fashion.

Interestingly, the Yellowstone fires of 1988 were referenced in five separate interviews. Some people used Yellowstone as an example of let-burn policies gone wrong, whereas others used them as an example of how burned areas can recover.

ET: I've been to Yellowstone National Park before the fire and after the fire, so that's what my feeling is, it's ugly, the part that burned.

KM: Like Yellowstone, we've been back there since and it recovers.

Table 13: Interview codes: the role of fire and local forest health. Hayfork, CA, 2009.

Theme	# of interviews	Percent of interviews	# of times discussed
<i>Role of fire</i>			
Fire is a natural process	14	78%	37
Role of fire positive	8	44%	20
Role of fire unclear	3	17%	5
<i>Wildland fire</i>			
Support for let-burn policies	5	28%	9
Disapproval for let-burn policies	6	33%	10
Controlled fire better than wildfire/natural fire	4	22%	5
Support for fire suppression activities	6	33%	7
1988 fire in Yellowstone	5	28%	5
Wildfire – impacts on air quality	7	39%	15
<i>Forest health</i>			
Local forest health good	4	22%	5
Local forest health bad	8	44%	9
Fire suppression – negative impacts on forest health	9	50%	13
Logging increases fire risk/degrades forest health	10	56%	21

As evidenced in this section, landowners in the Hayfork area generally acknowledged that fire has a natural and important role in local forests. More controversial was the way that fire should be expressed on the landscape and the role that humans should play in this expression.

Local Forest Health

Though some Hayfork-area landowners commented on the good health of nearby forests, local forests were largely perceived as being in poor condition (44%, 9) (Table 13). For many, poor forest health was related to the impacts of fire suppression (50%, 13) and logging activities (56%, 21).

ED: It's overgrown. It's like a time bomb.

KR: The early forests here probably only ran about 50 trees to the acre. Maybe 80, but more like 50...[my dad] always talked about the huge pines out [in Indian Valley] and how spaced out they were, it was park like, and some of those pines they brought out of there were just absolutely awesome. One log on a truck coming out of Indian Valley grade, you were taking your life in your hands. They were huge...And then when they started putting out all the fires, now you have this second growth jungle, which is not good for the growth of the trees, they're choking each other, it's a total fire hazard, and bugs and everything else, and the range is gone, the multi-purpose of it is gone, and the wildlife can't survive in that either. It's a lose-lose, the way I see it.

ET: I think [local forests] are very burnable because of the logging practices that have taken place. Like with Sierra Pacific, they take the big trees, leave the slash, leave the brush, that's happened all over the place.

IG: This reminds me of how people talk about babies, and how you can't protect them from all the germs and bacteria out there. You even want them to be exposed to some extent because then they might get sick but then their body learns to fight it. And in this day and age, people are obsessed with antibacterial stuff, but it makes the situation worse because then when people do get sick, their body does not know how to deal with it and it could be the death of them. And this reminds me of that, where

it's like you're fighting so hard to prevent something that's natural so that when it does happen, you just make it worse.

Interestingly, those that felt local forests were healthy spoke only of the areas surrounding their homes – the areas for which they were responsible.

LF: Well I think the forest around here, by us, is very healthy.

NR: I think in our area, we have pretty healthy forests and not much needs to be done. Where we are.

MJ: I have a healthy forest, and the reason for that is because my husband and my son have been working for the past 60 years maintaining it so that it will be healthy.

For many, there was a strong connection between forest health and the human relationship with the landscape. Landowners tended to share the belief that it was human interference in natural processes that disrupted the natural flow and health of local forests, yet they also envisioned human stewardship as a core tenet of progress and resilience.

Need for Year-Round Management and Personal Responsibility

The need for year-round forest and fire management was stressed by many (72%, 23) (Table 14). Landowners expressed frustration with the seasonal nature of fire management, with fire suppression taking priority over fire hazard reduction. They also drew a connection between year-round management and the creation of local jobs (33%, 7).

SM: You know, there's so much money spent to put the fires out, but never enough money to do preventative work, like thinning from below and cutting out ladder fuels and clearing in certain zones with fire breaks and roads so that then you could put fire into an area and let it underburn to keep it that way.

KR: I think we should have adequate fire crews in the summer, but it should be a year round job and they burn over the winter and work at it. And they're trained, in shape, and they're doing a service the whole time. It should be a full time job, and it never has been.

ED: So I think what they ought to do is all these crews that they have in the summer, and they pay them very good and they do a very good job, but then they lay them all off in the winter and they're all on unemployment right now... They've got the infrastructure. They're set up. They've got the leaders, the platoon leaders, they've got the crews. They have everybody and they're just... sitting around, and they could be out cutting brush along the roadways right now and doing just like I did and then set it afire when the weather's fine.

NW: They only have people jump on the fire when there's a fire, they should be doing a lot of preventative stuff and we wouldn't be having so many problems.

ET: I think the idea that we spend money in the off season on stuff like this is important. That's a great idea.

Personal responsibility was a major theme in the interviews (56%, 27) (Table 14).

Though they stressed the need for year-round management on surrounding public lands, landowners did not ignore their roles in reducing fire hazard.

DC: People definitely need to take some initiative and clean up around their places. The Forest Service may not be doing their best job on a lot of this stuff, but those guys don't deserve to get burned up because someone's too lazy to clear brush around their house... If people expect the Forest Service to come in and save their place when they haven't done anything ahead of time, it's just not going to happen, and if people would do that, we'd probably solve a lot of the fire problem we have.

EV: [People aren't] being proactive when they should be, and then there's so much upset after the fact, but it's always easy to do something after the fact. It's hard to make the hard choice and do what you should, that could cost money and time and all these things, compromises to your own land, even, to be safe. And I think all of us... need to rely less on the government and more on ourselves and take back some of that power. And do what we need to do. Instead of acting like we don't need to do

anything and then being mad at the government when they don't do it our way or something. That needs to change.

CG: Everyone needs to be educated and conscious of [fire]. I think around here, no one wants to have strangers on their property anyway, just because that's the whole good feeling out here, unlike the city, you have a little piece of freedom, and yeah, you have to take care of it, or nature will take it from you. So you have to have that mind set of doing it yourself.

EE: [Fire risk] is something I try to deal with on my own property and make it a place that's a bit safer or a place where we can live without having to worry about fire coming our way. And I hope other people will do the same and clear the brush and keep things clean. I think it has to be part of the deal.

CS: Do they really care if our house burns down? No. Nor in the farthest sense should they. I chose to live in the middle of the forest. I chose to live here and I know there's a risk and I'll do whatever I'm supposed to do to minimize that risk, but really, it could happen. But I would like to know that my national agency, whether I'm here or not, is doing something to protect the [forest] and not just letting it accumulate and burn.



Figure 7: Forest near a home in Hayfork, CA. Landowner has removed shrubs and pruned trees to reduce fire hazard. April 2009.

Prescribed Fire

There was widespread support for prescribed fire among the landowners included in this study (67%, 35). As mentioned previously, five of the properties are currently managed with some form of landowner-ignited prescribed burning, and one other property – adjacent to Highway 3 – was similarly managed until pressure from authorities forced the landowner to quit burning several decades ago. Those landowners that didn't use prescribed fire generally understood and supported its use; many felt that it could be an effective way of reducing fuels and making the landscape more resilient.

NR: I think it's smart. In some areas, there are still the air quality concerns, but it does make the forest and the area around you healthier and safer.

HR: If I had lit the field on fire, which I haven't done in a few years...that field would be pretty resilient, not a conduit for the fire like it is now.

KR: Probably one reason why we haven't had wildfire on this property is because [we] used to do a lot of burning in the spring...we had a lot of planted timber, about a mile of it along the road up here, and it was always a concern that someone would torch it or throw a cigarette, and so every spring we burned it...burned off the duff to keep it clean. We did that up until the Forest Service and everybody started getting antsy every time you dropped a match, so we quit doing that.

KB: If it wasn't for the air board and the Forest Service and Cal Fire, I would have burned this about 2 weeks ago. I would just start up by the road and get it burning, and move it down the hill, and burn it all the way down to here. I had to kill five or six thousand little brush plants with a grubbing tool this winter, and I'd much rather use fire to do that than my old shoulders.

CS: You can either have smoke for a few weeks in the fall or you can have smoke all year long.



Figure 8: Recently burned ponderosa pine/white oak stand on private property near Hayfork, CA. Landowner has been prescribed burning this stand approximately every three years since the 1970s. February 2009.

As indicated above in the first quote, air quality impacts from prescribed fire were an issue for some people (22%, 5). Yet the air quality issue came up much less frequently than the competency of those managing prescribed fire activities. Many indicated conditional support for prescribed fire (50%, 11), outlining specific situations wherein they would or would not support management-ignited burns. The 1999 Lewiston (Lowden) fire – an escaped BLM prescribed burn – was mentioned in seven different interviews, its legacy continuing to impact local support.

MJ: I used to think controlled burns were okay until the BLM burnt down all of Lewiston. You have to have somebody with some common sense who knows weather patterns. There's a lot that goes into a controlled burn, and unless you have someone who's vigilant and understands all of that, which doesn't seem to be happening lately, I'm really not for a controlled burn.

KR: I believe in burning, I think we need a lot more of it, and it's the right way to go if it's done right. When we have someone like in Lewiston, hot windy afternoon and two or three people told them not to do it, and they just told them to get lost and did it anyway, that type of stuff is what gives it all a bad name. It's bad news. But controlled burns are really the thing.

LF: As far as a control burn goes, I'd go for it if they did it in a controlled way.

Table 14: Interview codes: forest management and prescribed fire. Hayfork, CA, 2009.

Theme	# of interviews (N = 18)	Percent of interviews	# of times discussed
<i>Responsibility</i>			
Responsibility for fire hazard mitigation – government	2	11%	2
Responsibility for fire hazard mitigation – landowner	10	56%	27
<i>Forest Management</i>			
Need for year-round management	13	72%	23
Year-round management creates local jobs	6	33%	7
Access important - keep roads open	4	22%	5
Need for local control/knowledge	10	56%	22
NRCS – good to work with	6	33%	9
<i>Prescribed fire</i>			
Prescribed fire good	12	67%	35
Personal use of prescribed fire	6	33%	10
Conditional support for prescribed fire	9	50%	11
Manager liability a barrier	5	28%	7
Prescribed fire bad	3	17%	7
Prescribed fire – impacts on air quality	4	22%	5
Lewiston escaped Rx burn	7	39%	7
<i>Logging/thinning</i>			
Thinning reduces fire risk	13	72%	25
Logging increases fire risk	10	56%	21
Logging related to availability of local fire personnel	3	17%	7
Support for salvage logging	5	28%	9
Disapproval for salvage logging	1	6%	3

Relationship with Land Managers and Impacts on Support

Though many landowners in this study felt that fire was a natural process, recognized that fire has many benefits, and generally supported the idea of prescribed burning (some using it themselves), support for management-ignited prescribed burns remained conditional. Consideration of larger issues around fire and forest management illuminates dynamics by which support may be rendered conditional. The relationship between community members and land management agencies, especially the USFS, is long and complicated and was heavily affected by experiences during the 2008 fire season (Figure 9). Lack of trust in the USFS was a major issue identified in this research (61%, 25), related to perceptions of agency incompetence (56%, 39), profiteering (44%, 15), and lack of local authority (67%, 24) (Table 15).



Figure 9: Air quality in the Hayfork Valley during the 2008 fire season.

Many landowners made general comments about a lack of trust in the USFS and its strategies for fire protection. National forest lands were perceived by many as unmanaged and dangerous.

FC: I'll do it (prescribed burn) when the time comes because I don't trust the Forest Service to look after this place for me.

MJ: Yes, we have logged, but it wasn't strip logging or clear-cutting or anything else, it was respectful to the environment, it was respectful to our neighbors, and our neighbors on both sides are respectful. Our neighbors to the south—the Forest Service—are not so respectful.

ED: Our biggest danger is the national forest.

Lack of trust emerged from experiences with both fire and forest management.

The legacy of the timber wars resonated in the community, and the connection between fire hazard and logging was mentioned several times.

NR: Well, when we first came we thought “oh, the Forest Service, they're our friend.” But we didn't realize how they were involved in the whole logging off of the forest, but we soon learned, and we soon learned how to deal with the bureaucracy as best we could.

HR: They can do thinning to protect private property, but when I listen to some of the folks in Hayfork...to me it's just another, you know, dealing with their timber past, they see it as a way to get logs.

ET: Forest management has been influenced by how much money they can make on a piece of property, and I noticed the Forest Service that came up with Sierra Pacific – when they came to check for owls and things – they were very friendly, very close to Sierra Pacific.

JJ: Even people who agree with control burning and thinning have such distrust, they don't trust the Forest Service and you know, I have the same sort of mindset because of the history. Not even after the summer, it just seems like for the Forest Service, the special interests...have always been premier before the health of the forest.

Agency incompetence was one of the most prevalent themes surrounding trust.

Many of the comments stemmed from experiences that landowners had with fire suppression efforts.

LF: [The fires] were just handled very badly...the left hand didn't know what the right hand was doing.

NR: In 2006, where it burned over there at the Titlow place, they sent people in—we called it in 'cause we saw the smoke—they had people up on the Southfork looking for the fire, when it's a different mountain. It seems to me that that kind of mistake is inexcusable.

EM: We have had an experience with the Forest Service that does not give us confidence.

The use of “burnouts” (or “back-burns” or “back-fires”, as many referred to them) was a very contentious issue during the 2008 fire season in Hayfork and other parts of northern California. This topic came up many times in the interviews (44%, 15), as landowners felt that fire severity was much worse in the burnouts than in the areas that burned naturally. The sense that the USFS was lighting destructive fires only to stop low-intensity, natural fires contributed to perceptions of agency incompetence and poor judgment.

HR: If you go about 10 minutes down the road...you'd start to see where they did the burnouts, and that's pretty much all the crowning, where they did the burnouts.

LF: They just got totally out of control and the back-burns were worse than the forest fire...It's just black. It's horrid. It's just solid black. They've just ruined the forest, absolutely ruined.

JJ: People were already exposed to excessive amounts of smoke for so long and then to back-burn and the back-burns getting out of control, so they started all these fires and they couldn't contain all of them, so that was excessive. It could have been done differently.

EM: Well, the backfiring can backfire...The policy of using backfires has problems from the standpoint that it seems to us they can let a lot more of the forest burn using that process in the guise of trying to protect the firefighters. That protection is important, of course, but have we gone overboard?

Trust was also impacted by the belief that profits from wildfires are a disincentive for proactive management. Many landowners brought this up during interviews (39%, 13).

ED: [Fire suppression] is just a tool to make more money instead of actually doing any good. I would say 80% of the people are just in it for money...I mean, look at the amount of money that was turned over. So why would they, in my opinion, why would they want to come out here and prevent fires? Because then they're going to lose that big dollar... I think it's the money. You take the money out of it, and they'd all leave. How many of them would really be concerned with the forest if you took the money out?

CS: It's not really about the health of the forest. When did [fire] become important? When Tahoe and San Diego burned down. Why? Because those homes cost 6 million dollars. If it had just been us [in Hayfork]...it wouldn't have mattered. So when you're making your policy directly related to pressure from money, it's not really about the health of the forest.

Many landowners discussed the organization of USFS fire management activities. The idea that fire suppression crews during the 2008 fire season were not local emerged as a major theme during these discussions (67%, 24); landowners indicated that the crews' lack of local knowledge was the cause of many problems that occurred, including destructive daytime burnouts.

LF: So they started putting in fire-lines and they had people up here that had no idea where anything was at, they were running around saying "where is this, where is that?"...They were from Ohio, Guam. So nobody

knew the country...They didn't know where they were at, they didn't know where the roads were or how they could get in or out, or anything else.

MJ: Everyone in Hayfork knows the Lucky Jeep Trail. We all know where the trail is. And the man who's running the meeting, who's in charge, says "I'm sorry, I don't know where the Lucky Jeep Trail is." And there were hundreds of people in this meeting, and there was a group sigh. It was horrid. And it wasn't that man's fault, but how can you call the shots when you're not familiar with the area, the terrain, the people, any of it.

TS: We [used to have] all the loggers that knew the country and you had cats with winches with guys who could cut firelines instead of somebody who builds parking lots in Redding or in the Valley trying to push with a ripper cat. And you had people who were local and knew the country instead of people who come from all over and don't know how to find Indian Valley, let alone what ridge to go down...If you have the right people at the right time with the right knowledge and experience, you can do a lot more.

Though thankful for the firefighters' hard work, landowners expressed concern that locals were excluded from fire suppression efforts.

KM: Sometimes it seems like they don't want to bring in the locals who know about it, and we should have the pre-training of the locals who could go out, and it used to be that they could make a lot of money, the water tenders and the people with chainsaws and everything, but they don't always get to do it.

NR: There needs to be liaison with the local fire departments who know where things are and they don't do that. Why didn't the Forest Service do that? Instead, they got their maps, their way of doing things, and so that's another reason for distrust with the Forest Service.

Many landowners made a point of acknowledging local USFS personnel, who they generally liked and appreciated (33%, 7). Yet they expressed concern that local personnel have little control over what happens in local forests; the idea that decisions are

made elsewhere and that local USFS staff are relatively powerless emerged in several interviews.

ET: The other thing is that while I have no complaints about local people who work for the Forest Service, the policies are dictated from above, generally by a political appointee who knows diddly shit about managing a forest, they're just somebody who gets a pat on the head and a nice job because they did something.

KR: I don't like to pick on the Forest Service, a lot of nice people work there. But it's bad politics, is what it is. These people here don't have anything to say, they get told what to do, and they got to do it if they like their job, even though they may not agree with it.

ED: I don't think it's so much the people locally, it's probably in the high courts where the problem is. Our forests are burning up because of what's going on in Washington DC.

Table 15: Interview codes: USFS fire management. Hayfork, CA, 2009.

Theme	# of interviews (N = 18)	Percent of interviews	# of times discussed
<i>Trust</i>			
Trust for USFS	3	17%	5
USFS – communication efforts good	4	22%	4
Lack of trust for USFS	11	61%	25
Fire suppression/management financially motivated	8	44%	15
USFS incompetent	10	56%	39
USFS – poor communication	5	28%	6
Fire suppression – crews not local	12	67%	24
Private property incident	4	22%	5
Fire severity worst in backfires	8	44%	15
<i>Organization of fire suppression/management efforts</i>			
Different crews cycling in bad	6	33%	8
Local USFS people good, but larger structure bad	6	33%	7
Individual crews/people very good	6	33%	10
Policy has changed over years	4	22%	8
Air quality decisions not local	2	11%	3

Discussion

Fire management in Hayfork represents much more than fire suppression and the mitigation of risks associated with wildfire; fire management is a single node on the web of resource management, history, and relationships that defines the Hayfork community. Fire management is a source of debate, controversy, and inspiration, engaging people from all walks of life in a single, pressing issue.

Much research has explored public attitudes toward fire management policies, including fuels treatments and prescribed fire. Yet much of this research has focused on WUI areas near urban or suburban centers – areas where population growth and development are prevalent concerns. Little research on public attitudes has focused on rural communities, where residents are tied to their landscapes through time, experience, livelihood, and necessity.

Support for Prescribed Fire

In concert with other research on public acceptability of prescribed fire, this research demonstrates widespread support for prescribed fire and other fuels treatments by landowners in the Hayfork area. Support is reflected by landowners' acknowledgement of the role of fire in local ecosystems and the shared perception that fire suppression, as a management strategy, is a mistake. This is not to say that Hayfork-area landowners do not support fire suppression activities at this point in time; in fact, many of them feel that current conditions – engendered by fire suppression and past

forest management – necessitate continued suppression activities until forests are returned to a balanced or “natural” condition. Prescribed fire, in the eyes of many, should play a major role in reintroducing fire to local ecosystems.

As mentioned in the results, many landowners in the Hayfork area use or have used prescribed fire on their own properties. Landowners were not selected for this attribute, and the use of fire by subjects in this research is merely coincidental. Yet the current use of fire on five of the 18 properties included in this study reflects the value of a rural approach to prescribed fire and fuels treatments. In many cases, landowners in Hayfork have formed opinions of fire management based on personal experiences and knowledge, and where landowners from a range of backgrounds – from environmentalists to ranchers – have used prescribed fire, an even wider range of people understand and support its use.

Prescribed fire is perceived by many in Hayfork as an important element of a year-round strategy for forest management and fire hazard mitigation. Many landowners have noticed and are supportive of fuels reduction work completed in the area, much of it implemented by the Watershed Research and Training Center and funded through the Resource Advisory Committee (RAC). Though perceptions of the relationship between logging and fire hazard vary greatly, most people agree that the thinning of small trees and the removal of shrubs should be important components of fire hazard reduction. The connection between year-round management and local job creation is also important, mentioned by many through the course of the interviews.

Though support for prescribed fire is widespread, support for wildland fire use (WFU) is a largely contested issue in Hayfork. Many are uncomfortable with the idea of letting wildfires burn, and they prefer controlled, management-ignited fire to naturally-ignited fires. Lack of support for WFU is often tied to the perception that local forests are, after a century of intense management, in an unnatural condition, one that renders them more vulnerable to wildfire. Likewise, many consider summer the wrong time for fires to be burning, indicating that controlled burns in the spring or fall would be easier to manage and have a more positive impact. A handful of landowners do fully support wildland fire use decisions, arguing that the dry season is the natural time for fires to burn in the area. Interestingly, many landowners – both in support of WFU and not – feel that much of the area burned during the 2008 fire season looks good, or seems to have burned under relatively low-severity. Given the opportunity to tour burned areas, Hayfork-area residents may regard let-burn strategies more favorably; likewise, demonstration burns may be a useful tool for increasing understanding of and support for prescribed fire activities.

Influences on Support for Prescribed Fire

As discussed above, support for prescribed fire activities is fairly widespread in Hayfork – landowners recognize a need for year-round, proactive treatments, and many see prescribed fire as a valuable component of such strategies. Yet support is not simple; for many, it is highly conditional, dependent on landowner-agency dynamics and the experiences through which those dynamics have emerged.

Past works have highlighted the conditionality of support for fuels treatments in many areas, demonstrating public concern over logging operations masked as fuels reductions (Shouse 2002) and the risk of escapes with prescribed fire (Brunson and Evans 2005). Both of these issues distill to a single, broader, and very well-documented issue – trust in land managers (e.g., Shindler et al. 2002, Shindler and Toman 2003, Liljeblad and Borrie 2006). Even in areas where support for both thinning and prescribed fire operations is great, erosion of the agency-community relationship can be inhibitive (Shindler and Toman 2003). This research in Hayfork echoes such findings, suggesting that strong support for both thinning and prescribed fire may be thwarted by trust issues.

Though trust is influenced by a number of factors in Hayfork, a handful of specific incidents have had perhaps the greatest impact on the agency-community relationship. The Lowden Fire, an escaped prescribed burn that destroyed part of the nearby town of Lewiston in 1999, has heavily influenced perceptions of prescribed fire in the area. Paralleling what Brunson and Evans (2005) found in research on an escaped prescribed burn in Utah, the Lowden Fire does not appear to have greatly reduced support for prescribed fire as a practice, yet it did confirm the fallibility of managers and augment the context of conditionality within which prescribed fire activities occur.

Landowner experiences with fire suppression efforts have also contributed to the erosion of the agency-community relationship in Hayfork. During the 2008 fire season, several specific incidents sparked anger in the community, impacting trust in and support for the USFS. In one incident, fire suppression personnel bulldozed a wildflower meadow on private property after being instructed not to do so; the meadow, a beloved

part of that property, was converted into a staging area for heavy equipment. The incident fueled controversy in Hayfork, making headlines in the local newspaper (Morris 2008) and instigating much discussion in my interviews with landowners. Other similar incidents on private property, in concert with destructive burnout operations, have heavily impacted landowner trust in the agency. Interestingly, little research has explored the connection between experiences with fire suppression and support for fuels treatments, yet it proved to be a significant component of the dynamic in Hayfork.

The community-agency relationship is also impacted by perceptions of responsibility for forest health and management. In the interviews, many highlighted the role of private landowners in mitigating fire risk and promoting forest health. Likewise, all comments to the effect that local forests are healthy were in reference to areas on private property. The notion that public lands are unmanaged, unhealthy, and dangerous is somewhat widespread in Hayfork, indicating a general perception that public agencies are not fulfilling their responsibilities. Similar perceptions – both of private landowner responsibility and of public lands as a threat – have been documented in prior research. Qualitative research in Colorado found that WUI residents recognized the importance of self-reliance, emphasizing the roles that they must play in mitigating fire risk (Brenkert et al. 2006). Yet they also expressed shared concern that public lands are a risk, and that efforts on their properties may be undermined by dangers on nearby national forests.

For landowners in Hayfork, the unmanaged state of the forests – and the inability of the USFS to fulfill their responsibilities – is a complex issue, one deeply connected to the dissolution of the local timber industry in the 1990s. Many landowners emphasized

the link between the timber industry and fire management, arguing that funds from timber sales historically supported local fire crews and a vibrant agency staff. Landowners also argued that the timber industry provided for a close relationship between locals and the forest, enabling swift and effective fire suppression efforts. This is not to say that landowners ignored the connection between logging and increased fire risk; many felt that the removal of large trees, the creation of slash, and the replacement of natural stands with plantations greatly decreased fire resiliency in local forests. Yet regardless of individual landowners' feelings about logging, many shared the sense that changes in the timber industry marked the end of an era – both in forest and fire management – where locals were involved in and responsible for the management of the forests. Now, with a lack of local forest jobs and an underfunded USFS ranger district, there is concern over both the dwindling health of the forest and the increasingly limited role that local people – both community members and USFS staff – play in forest stewardship.

CONCLUSIONS

This research in northern California approached prescribed fire from two angles – the management perspective and the community perspective. Unlike related works, which have focused solely on one perspective or the other for a given region, this research has attempted to document the issues – diverse and complex – that face the increased use of prescribed fire in the region. As demonstrated in this work, there is a wide range of constraints facing the use of prescribed fire in northern California; managers identified specific impediments and issues, and landowners expressed genuine interest in and concern with various aspects of prescribed fire implementation. Though the issues facing these two groups are, for the most part, as distinct as each group’s relationship with fire, there are areas where they clearly intersect.

Public Opinion

Of all the themes that emerged in this research, there was one that unmistakably drew the two studies (and their participants) together – public opinion. This research identified a tension between management and community perspectives on the importance of public opinion. Regional public lands managers identified it as one of the least limiting factors in the use of prescribed fire, and Hayfork-area landowners substantiated its apparent lack of importance, arguing that fire management operations appear insensitive to and exclusive of local concerns. Landowners discussed gradual changes in local forest and fire management over the years, indicating that what was once a locally-

based effort – tied to the timber industry and forest livelihoods – is now an increasingly top-down approach, one that is peripheral to community concerns and needs.

It is important to note that regional fire managers did not rate public opinion as *unimportant*; rather, they identified it as a factor that does not limit the expanded use of prescribed fire. Such a rating could indicate that public support is high and thereby not limiting, yet results from both Hayfork and prior research suggest that there is a bigger issue at hand. In a longitudinal study of forest communities in Oregon and Washington, Shindler and Toman (2003) found that though support for fuels reduction strategies – including prescribed fire and thinning – remained stable (and fairly high) over time, trust in the USFS to implement those strategies had declined. Levels of trust that were low in the initial study were even lower four years later, with only 52 percent of respondents expressing confidence in the agency. Interestingly, community members agreed that USFS efforts to collect public input had increased over time, yet the number of people who agreed that the agency used public input to make decisions and shape policy had severely declined. Other research has documented similar patterns (Shindler et al. 2002). Furthermore, a majority of respondents in those Oregon and Washington forest communities felt that the USFS did little to build trust and cooperation with community members (Shindler and Toman 2003). Many expressed trust for local USFS personnel, but felt that local operations were largely dictated from above and that local staff were powerless. This issue has likewise been identified in other research (Shindler et al. 2002).

As shown in the results of Part Two, Hayfork-area landowners share many of the concerns documented in the aforementioned research. In fact, trust was found to be by far the most important influence on support for prescribed fire and other management activities, related to perceptions of lack of local control (both by community members and local USFS staff) and agency incompetence, among other things. The building and maintenance of trust – through communication, integration of local knowledge and input, and sensitivity to public concerns – should likely be a primary element of agency strategies. Public opinion may not necessarily be limiting agency activity at this point, but considering the present erosion of agency-community relationships across the west coast and northern California (as described in Shindler et al. 2002, Shindler and Toman 2003, and this research, for example), it may become more limiting in time. Even those impediments that were identified by managers in this research as most limiting, such as narrow burn window and regulations, are inevitably tied – by the social and political processes through which they are defined – to public opinion and approval.

As evidenced in this research, successful prescribed fire programs are necessarily multi-faceted; implementation requires consideration of legal, social, biophysical, administrative, and other issues, causing great frustration in both land management and residential communities that hope to improve the health of local landscapes and reintroduce fire to ecosystems. As discussed above, there is a great need for better agency-community communication and collaboration in forest and fire management. Trust is an essential component of this relationship, and it should be a central goal of agency efforts. Yet there are many other areas where work is needed; this study's survey

of regional fire managers highlighted the importance of both operational and regulatory issues, which currently limit prescribed fire activity in northern California more than anything else. The formation of the Northwestern California Prescribed Fire Council – currently in progress – is timely; the council will work to identify and address the most important constraints on prescribed fire activity in the region, drawing on the experience and knowledge of federal and state agencies, tribes, timber companies, fire safe councils, watershed groups, private landowners, and others. Prescribed fire councils have been active in many parts of the country for over a decade, offering useful resources and inspiring models of progress for this region’s nascent project.

This research has demonstrated a perceived need for the increased use of prescribed fire in northern California; both land managers and community members stressed the need for proactive management, identifying prescribed fire as a critical component of any strategy. The era of fire exclusion has lasted well beyond its time, compelling action on all levels – from the landowners in Hayfork who burn five acres a year to the US Fish and Wildlife Service, which burns over 20,000 acres a year just in northern California. May this work be a resource for interested parties, a jumping-off point for further research, and a testament to the inevitable – and undeniably pivotal – role of fire in this region.

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APPENDIX A

Area treated with prescribed fire by agency/management area (ac.), northern California, 2006-2008.

	2006	2007	2008
USFS TOTAL	19508	17791	20882
<i>Shasta-Trinity NF Total</i>	2907	1230	2420
Weaverville and Big Bar RDs (Trinity River Management Unit)	0	337	546
Shasta Lake NRA	550	475	1050
Hayfork and Yolla Bolla RDs (South Fork Management Unit)	157	418	674
Mt. Shasta RD	2200	0	150
<i>Six Rivers NF Total</i>	315	415	405
Smith River NRA	0	0	35
Lower Trinity RD	225	200	175
Mad River RD	90	215	195
Orleans RD ²⁶			
<i>Mendocino NF Total</i>	2834	3592	3298
Upper Lake and Covelo RDs	234	1092	548
Grindstone RD	2500	2500	2750
<i>Plumas NF Total</i>	765	711	1032
Beckwourth RD	500	500	650
Mt. Hough RD	265	211	382
Feather River RD	nr ²⁷	nr	nr
<i>Modoc NF Total</i>	385	574	3168
Devil's Garden and Warner MT RDs	135	574	1768
Doublehead RD	250	0	1400
Big Valley RD	nr	nr	nr
<i>Lassen NF Total</i>	5971	4878	3934
Hat Creek RD	4000	3500	2500
Eagle Lake RD	1500	1200	1200
Almanor RD	471	178	234

²⁶ One manager provided combined information for the Ukonom and Orleans Ranger Districts, both in Orleans, CA but in different national forests (Klamath and Six Rivers, respectively).

²⁷ nr = not reported

(continued)	2006	2007	2008
<i>Klamath NF Total</i>	6431	6391	6625
Happy Camp RD	353	907	750
Ukonom RD	3	0	3
Salmon and Scott River RD	3575	2984	3372
Gooseneck RD	2500	2500	2500
BLM TOTAL	850	2329	2172
Redding Field Office	200	0	0
Arcata Field Office	0	39	10
Ukiah Field Office	250	1562	42
Eagle Lake Field Office	150	150	200
Alturus Field Office	50	136	1700
Surprise Field Office	200	442	220
CAL FIRE TOTAL	4246	5771	2741
Humboldt-Del Norte Unit	46	171	18
Tehama-Glenn Unit	1500	2200	723
Siskiyou Unit	0	0	0
Shasta-Trinity Unit	0	0	0
Sonoma-Lake-Napa Unit	700	700	700
Butte Unit	1500	1200	1300
Mendocino Unit	500	1500	0
Lassen-Modoc Unit	nr	nr	nr
Nevada-Yuba-Placer Unit	nr	nr	nr
NPS TOTAL	10610	3622	1743
Redwood National Park	245	256	700
Point Reyes National Seashore	20	0	78
Whiskeytown NRA	0	0	672
Lava Beds and Oregon Caves National Monument	6420	1836	0
Lassen National Park	3800	1500	158
Golden Gate NRA	125	30	135
CDPR TOTAL	25	182	110
Northern Buttes District	0	20	0
Diablo Vista District	0	0	0
North Coast Redwoods District	25	112	110
Mendocino District	0	50	0
Marin District	0	0	0

(continued)	2006	2007	2008
Russian River District	0	0	0
FWS TOTAL	20129	20063	21283
Klamath NWR	20129	20063	20783
Modoc NWR	0	0	500
TIMBER COs TOTAL	328	265	239
TC 1	200	200	200
TC 2	88	45	39
TC 3	0	0	0
TC 4	0	0	0
TC 5	40	20	0
TC 6	0	0	0
TC 7	0	0	0
TRIBES TOTAL	0	0	0
Round Valley	0	0	0
Yurok	0	0	0
NGOs TOTAL	42	51	57
NGO 1	0	0	0
NGO 2	42	51	57
NGO 3	0	0	0
TOTAL ALL	55,738	50,074	49,227

Size of management area by agency; average area burned by entity; area needed to achieve management objectives by entity; percent burned of management area; and percent burned of area needed.

	Acreage of Management Area	Average Acreage Burned (2006- 2008)	Acreage Needed to Achieve Management Objectives	Percent Burned of Management Area	Percent Burned of Area Needed
USFS TOTAL	8,490,163	19394	60300	0.23	32.16
<i>Shasta-Trinity NF</i>					
<i>Total</i>	<i>2,734,576</i>	<i>2186</i>	<i>11750</i>	<i>0.08</i>	<i>18.6</i>
Weaverville and Big Bar RDs (Trinity River Management Unit)	794,863	294	7500	0.04	3.92
Shasta Lake NRA	325,000	692	3250	0.21	21.29
Hayfork and Yolla Bolla RDs (South Fork Management Unit)	614,713	416	1000	0.07	41.6
Mt. Shasta RD	1,000,000	783	nr	0.08	nr
<i>Six Rivers NF Total</i>	<i>705,000</i>	<i>378</i>	<i>850</i>	<i>0.05</i>	<i>44.47</i>
Smith River NRA	305,000	12	100	0.004	12
Lower Trinity RD	180,000	200	250	0.11	80
Mad River RD	220,000	167	500	0.08	33.4
Orleans RD					
<i>Mendocino NF Total</i>	<i>825,000</i>	<i>3241</i>	<i>17500</i>	<i>0.39</i>	<i>18.52</i>
Upper Lake and Covelo RDs	400,000	625	7500	0.16	8.33
Grindstone RD	425,000	2583	10000	0.61	25.83
<i>Plumas NF Total</i>	<i>986,827</i>	<i>836</i>	<i>1300</i>	<i>0.09</i>	<i>64.31</i>
Beckwourth RD	440,000	550	1000	0.13	55
Mt. Hough RD	546,827	286	300	0.05	95.33
Feather River RD	nr	nr	nr		nr
<i>Modoc NF Total</i>	<i>1,370,000</i>	<i>1376</i>	<i>6000</i>	<i>0.10</i>	<i>22.9</i>
Devil's Garden and Warner MT RDs	800,000	826	2000	0.10	41.3
Doublehead RD	570,000	550	4000	0.1	13.75
Big Valley RD	nr	nr	nr	-	nr

(continued)	Acreage of Management Area	Average Acreage Burned (2006-2008)	Acreage Needed to Achieve Management Objectives	Percent Burned of Management Area	Percent Burned of Area Needed
<i>Lassen NF Total</i>	1,328,760	4928	16750	0.37	29.42
Hat Creek RD	450,000	3333	15000	0.74	22.22
Eagle Lake RD	330,000	1300	nr	0.39	0.39
Almanor RD	548,760	294	1750	0.05	16.8
<i>Klamath NF Total</i>	540,000	6482	6150	1.2	105.4
Happy Camp RD	nr	670	3000	-	22.3
Ukonom RD	500,000	2	0	0.0004	-
Salmon and Scott River RD	nr	3310	2750	-	120.36
Gooseneck RD	40,000	2500	400	6.25	625
BLM TOTAL	3,788,045	1784	13050	0.05	13.67
Redding Field Office	260,000	67	2500	0.03	2.68
Arcata Field Office	200,000	16	1000	0.008	1.6
Ukiah Field Office	325,000	618	2000	0.19	30.9
Eagle Lake Field Office	1,000,000	167	50	0.02	334
Alturas Field Office	503,045	629	2500	0.13	25.16
Surprise Field Office	1,500,000	287	5000	0.02	5.74
CAL FIRE TOTAL	-	4253	5450	-	78.04
Humboldt-Del Norte Unit	1,940,000	78	0	0.004	-
Tehama-Glenn Unit	nr	1474	2000	-	73.7
Siskiyou Unit	1,300,000	0	750	0	0
Shasta-Trinity Unit	nr	0	0	-	0
Sonoma-Lake-Napa Unit	nr	700	0	-	700
Butte Unit	622,398	1333	200	0.21	666.5
Mendocino Unit	25,000	667	2500	2.67	26.68
Lassen-Modoc Unit	nr	nr	nr	-	nr
Nevada-Yuba-Placer Unit	nr	nr	nr	-	nr
NPS TOTAL	441,560	5325	7572	1.21	70.33
Redwood National Park	7,000	400	1750	5.71	22.86

(continued)	Acreage of Management Area	Average Acreage Burned (2006- 2008)	Acreage Needed to Achieve Management Objectives	Percent Burned of Management Area	Percent Burned of Area Needed
Point Reyes National Seashore	90,000	33	0	0.04	-
Whiskeytown NRA Lava Beds and Oregon Caves National Monument	39,000	224	2200	0.57	10.18
Lassen National Park	46,560	2752	1822	5.91	151.04
Golden Gate NRA	109,000	1819	1500	1.67	121.27
CDPR TOTAL	150,000	97	300	0.06	32.33
Northern Buttes District	253,276	106	13150	0.04	0.81
Diablo Vista District	42,000	7	100	0.02	7
North Coast Redwoods District	40,000	0	5000	0	0
Mendocino District	104,000	82	8000	0.08	1.03
Marin District	26,000	17	50	0.07	34
Russian River District	14,276	0	0	0	0
FWS TOTAL	27,000	0	0	0	0
Klamath/Tule Lake NWRs	148,181	20492	27800	13.83	73.71
Modoc NWR	141,160	20325	27500	14.4	73.91
TIMBER Cos TOTAL	7,021	167	300	2.38	55.67
TC 1	1,488,500	277	6565	0.02	4.22
TC 2	250,000	200	1300	0.08	15.39
TC 3	70,000	57	40	0.08	142.5
TC 4	55,500	0	100	0	0
TC 5	280,000	0	5000	0	0
TC 6	174,000	20	125	0.01	16
TC 7	430,000	0	0	0	0
TRIBES TOTAL	229,000	0	0	0	0
Round Valley	42,000	0	0	0	0
Yurok	30,000	0	0	0	0
	12,000	0	0	0	0

(continued)	Acreage of Management Area	Average Acreage Burned (2006- 2008)	Acreage Needed to Achieve Management Objectives	Percent Burned of Management Area	Percent Burned of Area Needed
NGOs TOTAL	n/a	50	800	-	6.25
NGO 1	n/a	0	0	-	0
NGO 2	n/a	50	800	-	6.25
NGO 3	n/a	0	0	-	0
TOTAL ALL	14651725	51680	134687	0.04	38.37

APPENDIX B

SURVEY INSTRUMENT

Name:	Position:
Email:	Phone:
Name of Management Area:	

**For the purposes of this survey, prescribed fire refers only to broadcast burning.
It does not include pile or slash burning, wildland fire use, etc.**

▪ How long have you worked with your agency?

▪ Have you ever worked for another federal or state agency involved in fire management?

Yes No

▪ If so, which one?

▪ What is the total size of your management area (in acres)?

- In the last 3 years, how many acres did you *plan* to treat with prescribed fire, and how many acres did you end up treating?

	2006	2007	2008
Acreage of Planned Treatment			
Actual Acreage Treated			

- What is the annual acreage of prescribed burning needed to achieve management goals in your management area?

- Please rate the importance of the following **management objectives** to your prescribed burning program.

Click box next to number. Please select only ONE number per line.

<i>Management Objectives*</i>	Not Important Very Important									
Wildfire Hazard Reduction	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Ecosystem Management/ Restoration	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Wildlife Habitat Enhancement	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Site Preparation for Reforestation	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Cultural Resources	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>

Insect and Disease Management	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Vegetation Management	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Rangeland Improvement	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Other (please list):										
_____	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
_____	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>

- Please rate the following based on how much they **LIMIT** your ability to use prescribed fire:

Click box next to number. Please select only ONE number per line.

<i>Barriers*</i>	Not Limiting										Extremely Limiting
Public Opinion	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>	
Residential Zones Near Burn	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>	
Planning Costs	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>	
Site Preparation	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>	
Lack of Adequate Funding	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>	

Regulations (including air quality)	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Environmental Laws²⁸	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Liability	1 <input type="checkbox"/>	<input type="checkbox"/> 2	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Insurance Limitations²⁹	1 <input type="checkbox"/>	<input type="checkbox"/> 2	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Lack of Adequate Personnel	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Narrow Burn Window	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Fuel Loading	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Preference for Alternative Strategies	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>
Other (please list): _____	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>

²⁸ The environmental law category includes laws that protect water quality, endangered species, archaeological sites, and other resource values. Air quality and smoke management are not included in this category.

²⁹ High cost or limited availability.

- Please indicate your level of agreement with the following statements:
Click box next to number. Please select only ONE number per line.

“I am generally satisfied with the amount of prescribed burning achieved in my management area each year.”

Strongly Disagree	Disagree		Neutral		Agree		Strongly Agree		
1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>

“I wish that we could treat more acres in our management area with prescribed fire.”

Strongly Disagree	Disagree		Neutral		Agree		Strongly Agree		
1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>

“Managers must take personal risks in order to get prescribed fire on the ground.”

Strongly Disagree	Disagree		Neutral		Agree		Strongly Agree		
1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>

“I am willing to take personal risks in order to use prescribed fire in my management area.”

Strongly Disagree	Disagree		Neutral		Agree		Strongly Agree		
1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>	6 <input type="checkbox"/>	7 <input type="checkbox"/>	8 <input type="checkbox"/>	9 <input type="checkbox"/>	10 <input type="checkbox"/>

- Do you have any other comments on the issues raised in this survey or on anything else having to do with your prescribed burning program?

Would you like a copy of the survey results? Yes No

Thanks for your cooperation!

***Management objectives and barriers taken from a study by Cleaves et al. (2000) to allow for comparisons.**

APPENDIX C

HUMBOLDT STATE UNIVERSITY COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS IN RESEARCH

CONSENT TO ACT AS RESEARCH SUBJECT

Project Information:

This study involves research conducted by Lenya Quinn-Davidson, graduate student in the Environment and Community Program at Humboldt State University. The purpose of this research is to identify objectives for and barriers to prescribed burning in northern California. This research consists of a survey of fire managers in northern California. The survey is four pages long and covers a series of questions. Each fire manager will be contacted by phone before receiving the survey and this consent form by email. Results will not identify people by name in order to maintain confidentiality. Management areas may be directly referenced, but individual managers will not.

Informant Consent:

I, the informant, understand that the project described above presents no anticipated risks and/or discomforts and that it has possible benefits, such as providing a broad understanding of objectives for and barriers to prescribed burning in northern California.

If I have any questions about this research, I may contact:

Lenya Quinn-Davidson
Graduate Student
Environment and Community Graduate Program
Humboldt State University
Phone: (707) 272-0637 Email: lenyaqd@gmail.com

OR

Faculty Advisor:
Dr. Yvonne Everett
Professor, Humboldt State University
Work phone: (707) 826-4188 Email: yvonne.everett@humboldt.edu

I understand that they will answer any questions I may have concerning this investigation or the procedures at any time. I also understand that my participation in this study is entirely voluntary and that I may decline to enter this study or may withdraw from it at any time without jeopardy.

I understand that I will not be receiving any compensation for participating in this study.

By checking this box, I acknowledge the information stated on this form.

Name

Date
