Understanding Wildfire Mitigation Behavior in Central Oregon Homeowners

A study of central Oregon homeowners living in wildfire-prone landscapes and implications for wildfire policy

By Dan Roper

MPP Essay

Submitted to

Oregon State University

In partial fulfillment of the requirements for the degree of

Master of Public Policy

Presented December 9th, 2015

Abstract

A history of fire suppression, growth in the wildland-urban interface, and changing climate conditions, have created a fire regime in central Oregon that is growing in severity and intensity, putting more people and structures at risk and requiring a greater percentage of state and federal agency budgets to manage fires. Realization of the importance of individual homeowners in reducing wildfire risks has led to a growing interest in understanding what mitigation activities homeowners are completing around their homes and properties, as well as which factors are influencing their decisions. This research uses data from the *Public Attitudes toward Wildfire in Central Oregon (2011)* to develop an OLS model of firewise behavior that seeks to explain the leading factors affecting firewise behavior in this central Oregon study group. It includes several variables created from a series of factor analyses that are assumed to measure concern about wildfire and opinions on public land and wildfire management. The results from the model suggest a number of policy recommendations for promoting firewise behavior. The intent of this essay is to describe current wildfire trends and management in the western US with an emphasis on wildfire mitigation by homeowners, and it concludes with an analysis of policy options for addressing this modern wildfire problem.

Abstract Approved by:

Roger Hammer

Master of Public Policy Essay by Dan Roper presented on December 9th, 2015

APPROVED:

Roger Hammer, representing Sociology

Brent Steel, representing Political Science

Sally Duncan, representing OPAL

Acknowledgements

I would first like to thank my committee for all of their support throughout the process of conducting research, analyzing data, and writing this essay. I would also like to thank the School of Public Policy at Oregon State for all of its support over the past two years. I've learned a tremendous amount during my time in the program and owe a great debt to all of those who have helped me along the way. Finally, I'd like to thank my cohort for helping to make this the enjoyable experience it was. Best of luck to you all!

This research was supported by the grant "Coupled Natural and Human Systems in Fire-Prone Landscapes: Interactions, Dynamics and Adaption," *National Science Foundation* (2010-2014).

Table of Contents

List of Figures:

List of Tables:

Understanding Wildfire Mitigation Behavior in Central Oregon Homeowners

A study of central Oregon homeowners living in wildfire-prone landscapes and implications for wildfire policy

Introduction

Each year western wildfires are growing larger, burning longer, and becoming more destructive and expensive to fight. The reasons are understood- changes in the climate have created drier conditions, previous management decisions have increased fuel loads in forests and some rangelands, humans continue to expand into places where there is a greater risk of exposure to wildfires, and many homeowners and entire communities are ill-prepared to defend their homes when fire occurs. Fire managers attempt to minimize damage to natural resources and property mostly by spending unprecedented amounts of money defending structures and suppressing approximately 98 percent of all wildfire ignitions (North and Stephens 2015). The funds that are spent on preventative measures, such as fuel reductions, including prescribed fire and mechanical thinning, and assistance to communities and homeowners to prepare for wildfire and mitigate their risks, does not appear to be substantial enough to reduce damages sustained in wildfires in recent years or to contain firefighting costs (Moritz et al. 2014).

Policymakers recognize the need for significant fire policy and management changes, especially when fire threatens their constituents, yet disagree over the best strategy to combat the growing wildfire problem. Ultimately, a politically viable and sustainable policy solution is needed – one that combats wildfire risks simultaneously in several key areas, including wildfire funding, forest health, community preparedness, and homeowner assistance. Previous research suggests that homeowners play a critical role in reducing wildfire risks and costs because the majority of wildfire suppression funds are spent protecting private homes and property (McCaffrey et al. 2013). This not only makes modern day wildfire management extremely expensive, but it consumes funds that could be used for reducing wildfire risks to public forests and private lands. One key strategy aimed at reducing wildfire risks for homeowners is encouraging adoption of firewise actions. Firewise actions are specific tasks homeowners can take to reduce risks around their homes and property and include clearing brush, thinning

vegetation around the home, cleaning gutters, using fire-resistant building materials, and developing a fire evacuation plan (Bright and Burtz 2006).

The purpose of this paper is to provide an overview of the growing wildfire problem, identify important issues in wildfire management and policy today, and describe the importance of homeowners to reducing wildfire risks and costs. It includes an analysis of data from a survey of residents in central Oregon that reveals the primary factors motivating homeowners to engage in firewise behavior. Central to this analysis is the development of a model of firewise behavior for homeowners based on the social science literature regarding homeowner wildfire mitigation, and more specifically on the work of Brenkert-Smith (2013). Unique to this model is the inclusion of several variables measuring primary wildfire concern and opinions on public land and wildfire management, created using a series of factor analyses.

Findings from the central Oregon survey present an opportunity to better understand motivating factors for engaging in firewise activities for homeowners in one fire-prone region. These findings add to the larger discussion taking place about the behavior of homeowners living in wildfire-prone landscapes, provide regional fire managers with a better understanding of homeowners in these Oregon counties, and help inform policy solutions for reducing wildfire risks in this region. This paper concludes with a discussion of policy strategies aimed at combating the growing wildfire problem. Although homeowners are just one element of this problem, understanding the factors that influence their engagement in wildfire mitigation is critical to reducing wildfire risks and costs and achieving more fire-adapted communities.

Background

The Wildfire Problem

Wildfire is a natural process in ecosystems throughout the western US, including the forests and rangelands of central Oregon (Dellasala et al. 2004). The historical role of wildfire in ecosystem processes is well-documented, with historic fire regimes varying depending on ecosystems, fuel availability, and other conditions (Dellasala et al. 2004). However, wildfires today are growing in size, frequency, and severity. There are several reasons for shifts in wildfire behavior, including increased biomass (also referred to as fuel-loading), a history of fire suppression, previous land management activities, and changing climatic conditions (Gorte 2013). Gorte (2013) suggests that previous land management practices, including grazing and

timber management, and 20th century fire suppression policies have increased fuel loads beyond historic levels, especially in those environments that typically experienced frequent but low-severity wildfire.

Changing climatic conditions exacerbate wildfire severity by increasing temperatures, producing drier conditions, and allowing for greater mountain pine beetle infestations throughout the western states and into Canada (Gorte 2013). Changing climate conditions have also increased the length of wildfire seasons. For example, in the western US the number of days in the fire season has increased from approximately 200 in 1980 to around 300 in 2013 (GAO 2015). The spread of invasive species like Cheatgrass and the expanded range of native species like Juniper (as is occurring in the Great Basin region of the western US, including parts of Oregon) have also contributed to increased frequency and severity of wildfires (GAO 2015).

Although wildfires provide numerous benefits to species and help maintain ecosystem health, they can also destroy or damage important natural and cultural resources, including watersheds that provide drinking water to communities (GAO 2015). Larger, hotter, and more frequent fires also pose significant risks to human communities and infrastructure. In the US, over 34,000 homes were destroyed by wildfire between 2003 and 2012, while suppression costs ranged between $1 to 2 billion per year during that same period (Ager et al. 2015). The highest property losses in the US commonly occur in southern California, where nearly 1,000 homes per year have been destroyed by wildfires since 2000 (Syphard et al. 2014).

The growing threats from wildfire and the challenges of managing it are exacerbated by growth of human populations in the wildland-urban interface (WUI), defined as the area where human settlement meets or intermingles with wildlands (Radeloff et al. 2005). Most of the human fatalities, home losses, and fire-suppression expenditures occur in the WUI (Moritz et al. 2014), and human population growth in the WUI continues even as it puts an unprecedented number homes, properties, and lives at risk (Hammer et al. 2009). Dombeck et al. (2004) state that an expanding human population, especially in western states, is the single greatest factor confounding federal fire management policies and it contributes to both increasing wildfire risks and costs. For example, in the 1960's an average of 209 structures were lost to wildfire each year, but in the 2000's that number grew to 2,726 structures lost each year (Austin and Salay 2012).

Approximately 70,000 communities nationwide are considered to be at high risk from wildland fire (GAO 2015). Sixty percent of new homes built in the US since 1990 have occurred in the WUI, and the WUI now contains 46 million single family homes and a population of approximately 120 million (GAO 2015). Nearly a quarter-million homes in the WUI worth an estimated $136 billion are considered to have a high or very high fire risk (Western Forestry Leadership Coalition 2010). While about 70 percent of the WUI is privately owned, only 14 percent of private WUI land is developed, suggesting that without changes in land-use planning, there is ample space for continued WUI growth (Moritz 2014).

An expanding WUI, a changing climate, and changing ecosystem conditions has led to a dramatic increase in fire expenses at the federal level, as well as for some states and local municipalities. The amount the US Forest Service spends on wildland fire management has increased from 17 percent of the agency's total funds in 1995 to 51 percent of funds in 2014 (GAO 2015). According to the US Government Accountability Office (2007), costs for federal agencies relating to wildfire averaged $2.9 billion between 2001 and 2005, and the majority of those funds are used to protect homes in the WUI (Paveglio et al. 2009). For the ten year period ending in 2014, the Forest Service and Department of Interior obligated $14.9 billion for fire suppression, $13.4 billion for fire preparedness, and $5.7 billion for fuel reduction (USDA Forest Service 2015). In fiscal years 2009 through 2014, the five federal wildland fire agencies obligated a total of $8.3 billion for wildfire suppression alone (GAO 2015). In 2013, the Forest Service had to divert $600 million from funds designated for timber, recreation, and other programs to its fire budget, marking the sixth year since 2002 that the agency had to divert funds to firefighting at the expense of other agency programs (Valentine 2013).

In addition to fire suppression costs, property losses, post-fire rehabilitation, and indirect costs greatly increase the overall cost to society from wildfire. Indirect costs include lost revenue from closure of recreation areas and tourism dependent economic activity, increased health costs due to exposure to smoke, water treatment costs due to due to increased sediment in water supplies, as well as the opportunity costs of investment in fire suppression (Western Forestry Leadership Coalition 2010). A team of researchers estimated the total, long-term costs of the 2003 Grand Prix, Old, and Padua Complex Fire in southern California to be $1.2 billion dollars, with only $61 million (5 percent) directly attributable to fire suppression (Western Forestry

Leadership Coalition 2010). Costs for wildfire protection and suppression are also increasing for many western states. For example, in 2015 Oregon spent over $120 million dollars on wildfire protection in 2015, more than two and a half time its base budget of $45 million (Oregon Department of Forestry 2015).

Despite the increased spending to combat wildfires, Gill and Stephens (2009) state that the collective efforts to reduce wildfire hazards do not appear to have reduced real losses of life and property. The level of fuel reduction over the past decade has remained relatively stable, averaging about 3 million acres annually, and is insufficient to treat the 230 million acres of federal lands at high or moderate risk of ecological damage from wildfires in a timely manner (Gorte 2013). Seventy-five million acres of federal lands are at high risk and another 156 million acres are at moderate risk of ecological damage from catastrophic wildfire. Since many ecosystems need to be treated on a 10-35 year cycle (depending on the ecosystem), current treatment rates are insufficient to address the problem.

Federal efforts aimed at preventing wildfires must increase their focus on private land and homeowners. For example, it has been shown that fire mitigation efforts within 100 feet of structures is the most effective method for reducing the likelihood of structural damage from wildfire (Syphard et al. 2014). Considering that the bulk of federal fire expenditures goes to wildfire suppression, and that most suppression funds go toward defending homes and structures in the WUI, fire policies must place greater emphasis on community and homeowner assistance. Currently, these programs account for only a small portion of state and federal agency fire budgets, overshadowed by firefighting and hazard fuels reduction (USDA Forest Service 2015).

Responses to large fires in the wildland-urban interface consistently involve calls for more fire suppression resources at the state and federal level, but wildfire suppression alone will not reduce the loss of life and property (Stephens et al. 2009). Stephens et al. (2009) suggest that human communities in the WUI must learn to coexist with fire, as we have attempted to do with other natural hazards, rather than simply fighting fire. The end goal of wildfire management varies, but Moritz et al. (2014) offers the following: “Coexistence with wildfire should ultimately allow ecologically appropriate fire regimes to operate on landscapes near and far from the WUI, with relatively low risks to people, property, and resources, while also allowing us to enjoy ecosystem services enhanced by fire”. Achieving such a future state would also reduce the costs

of fire suppression and risks to firefighters. Engaging WUI communities and homeowners in wildfire mitigation activities is a central component to achieving a sustainable coexistence with wildfire.

Wildfire Management and Policy

The management of wildfire in the western United States began in the early 20th century with a policy of suppressing all wildfires as quickly as possible and has gradually evolved to acknowledge the importance of managing fire for resource benefits (Busenberg 2004). Today, wildfire management emphasizes a combination of strategies including fire suppression, ecosystem management, and preventative measures, yet suppression of wildfire remains the leading management option for most fires and suppression activities consume the largest proportion of fire budgets (GAO 2015). In the US, approximately 98 percent of wildfire are suppressed before reaching 120 ha in size, but the two percent of wildfires that escape containment typically burn under extreme weather conditions in heavy fuel loads, and account for 97 percent of fire-fighting costs and total area burned (North and Stephens 2015). For the 2000-2008 period, only 0.4 percent of ignitions were allowed to burn as managed wildfires (North and Stephens 2015).

Federal Wildfire Policy can be thought of as an assemblage of laws, policies, and guidance accumulated over the past century. It has gradually evolved from suppression at all costs to acknowledging the natural role of fire on certain landscapes and managing wildfire for resource benefits under certain conditions (Busenberg 2004). The federal National Forest Management Act (NFMA) of 1976 and Federal Land Policy and Management Act (FLPMA) of 1976 both require the US Forest Service and Bureau of Land Management (BLM) to manage their lands under a multiple-use mandate (GAO 2015). The Forest Service and BLM collectively manage approximately 340 million acres of public lands, including millions of acres of lands in central Oregon, using a system of Forest Plans and Rangeland Management Plans that guide day to day actions at the district level and include local fire management plans (GAO 2015). Under the Federal Wildland Fire Management Policy of 1995, agencies moved further away from suppressing every fire and instead sought to reduce susceptibility of communities and resources to damage from wildfire and consider both the short and long-term consequences of fire management (GAO 2015).

The National Fire Plan of 2000 emphasized the importance of reducing hazardous fuels, and 2003's Healthy Forest Restoration Act (HFRA) aimed to reduce wildland fire risk to communities and resources through a collaborative process of planning and implementing fuel reduction projects (GAO 2015). The HFRA includes the first meaningful statutory incentives for the Forest Service and the BLM to give consideration to the priorities of local communities as they develop and implement forest management and hazardous fuel reduction projects (Society for American Foresters 2004). In order for a community to take full advantage of this new opportunity, it must first prepare a Community Wildfire Protection Plan (CWPP). Since 2009, federal agencies have made a number of changes in their approach to managing wildland fires, including issuing agency guidance to give mangers greater flexibility in responding to wildfires in other ways than full suppression and developing a strategy to coordinate federal and nonfederal fire management activities around common goals (GAO 2015).

The Federal Land Assistance, Management and Enhancement (FLAME) Act, passed in 2009, attempted to increase funding for wildfire suppression and prevent fire-borrowing by establishing two new wildfire funds - one for the Department of the Interior and one for the Forest Service (Forest and Rangelands 2010) These two funds were meant to reduce the need for agencies to transfer funds to wildfire suppression from other agency programs, but the Act has not had its intended effect. The FLAME Act also gave managers greater flexibility to manage wildland fire for natural resource benefits, including managing the same fire for different objectives and changing management objectives as the fire moves across a landscape (GAO 2015). The Act states that the use of fires will be based on land or resource management plans and associated fire management plans developed at the unit level. However, the effects of the changes are inconsistent because factors such as proximity to populated areas and lack of resources to actively manage fires limits the ability of fire managers to take advantage of these new management opportunities (GAO 2015).

The FLAME Act of 2009 also required the development of the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy), which set broad strategic direction for collaboration with partners across jurisdictions to coordinate wildfire management activities around common wildfire management goals. The Cohesive Strategy identified three goals: (1) landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with

management objectives; (2) human populations and infrastructure can withstand wildfire without loss of life or property; and (3) all jurisdictions participate in developing and implementing safe, effective, and efficient risk-based wildfire management decisions (GAO 2015). However, implementation of collaborative actions stemming from the Cohesive Strategy may be limited. For example, while the Act provided federal managers with additional flexibility in managing a single fire for multiple purposes, laws and regulations at the state and local levels typically require full suppression of all fires (GAO 2015).

States have taken different approaches to addressing wildfire risks and Burton (2013) suggests that state policies can be thought of as either "soft law" (e.g. public education, encouragement to adopt wildfire mitigation techniques) or "hard law" (i.e. regulatory mandates). Burton (2013) describes two distinct legislative approaches taken by western states to approach wildfire mitigation- a common standard and a local option. Common standards states are those adopting enforceable statewide wildfire mitigation standards for all property owners in the WUI, whereas local option states are those with no binding statewide WUI wildfire mitigation regulations (Burton 2013). By this simple definition Oregon is one of two common standard states, along with California, although a lack of enforcement of wildfire mandates can dampen the effect of the regulations.

While there is consensus among fire managers and researchers as to the benefits of homeowners' adopting firewise behaviors, Burton (2013) suggests there is less consensus among lawmakers as to whether the state should use its police powers to force homeowner's living in high wildfire risk areas to adopt such behaviors. In both common core and local option states, local municipalities are empowered to impose their own obligations on their communities, but in the common core states there is a common obligation across affected communities to undertake certain mitigation actions (Burton 2013).

California has the most comprehensive state regulations affecting WUI homeowners. California building codes mandate requirements for new building construction, including an emphasis on defensible space, access, and water requirements (Burton 2013). California building codes also establish building standards for all exterior walls and roofs located in the WUI (Burton 2013). California regulations set a minimum amount of defensible space up to 100 feet from homes necessary to adhere to the law and allows insurance companies to require defensible

space limitations of more than 100 feet (Burton 2013). Local jurisdictions can mandate stricter mitigations standards, but in order to adopt weaker ones they must prove that their standards will be as effective as the state's. In July 2011, California enacted a wildland fire prevention services fee of $150 per habitable structure for houses in the WUI to cover the state's additional fire protection costs (Gorte 2013).

Oregon has a number of regulations intended to reduce wildfire risks including prohibiting prescribed fires during the burning season, requiring smoke management plans to be filed in conjunction with burn plans, and regulating fire bans and closures to reduce accidental ignitions. In 1997, the Oregon legislature passed the Oregon Forestland-Urban Interface Fire Protection Act (SB 360), which called for identifying areas where residential development in wildfire-prone landscapes has occurred, classifying risks in those areas, and establishing fuel-reduction measures for each risk-classification. The Oregon Department of Forestry (ODF) mails new property owners in forestland-urban interface areas a certification form to voluntarily fill out and return. Homeowners are required to complete specific fire safety standards to reduce fire hazards around their homes, but there is no fine for not complying (Firewise.org 2015). However, a property owner may be billed for certain fire suppression costs if they do not comply with the fuel reduction requirements of the act. ODF is the state agency in charge of fire protection in Oregon and is responsible for enforcement of the state's wildfire mitigation mandates (Burton 2013). Local governments in Oregon lack the authority to enforce these forestland-urban interface mitigation measures.

Importance of Homeowners

Even the best management and planning is unlikely to prevent wildfires from threatening homes and property on vulnerable landscapes, therefore it is imperative that communities and homeowners take steps to mitigate their risks (Moritz et al. 2014). One of the most commonly recommended strategies for reducing risk of a home being lost or damaged by wildfire is to create and maintain a defensible space immediately around the home (Winter et al. 2009). Syphard et al. (2014) describe defensible space as an area around a structure where vegetation has been modified, typically resulting in reduced vegetation density, to increase the chance of a structure surviving a wildfire. Coleman (1995) views defensible space as an area where there is the use of "fuel and vegetative management to reduce fire exposure to a vulnerable structure" (Gill and Stephens 2009).

Increasing evidence suggests that one of the best ways to mitigate risk of structure loss from wildfire is to focus first on the home and then move in an outwardly direction. Most structure losses attributed to wildfire are due to embers - flaming or smoldering plant material that can travel up to 2 kilometers from a fire- rather than direct contact between the actual fire and the structure (Stephens et al. 2009; Moritz et al. 2014). The National Fire Protection Association's (NFPA) Firewise Communities Program recommends homeowners apply the zone concept for safeguarding their homes and properties. Zone 1 includes the area 30 feet adjacent to the home and its attachments; Zone 2 includes the area 30 to 100 feet from the home; and Zone 3 extends 100 to 200 feet from the home (Firewise.org 2015). Syphard et al.'s (2012) study of defensible space and homes damaged by wildfire in southern California showed effective distances were on average much shorter than 30 meters, and that greater than 30 meters did not significantly reduce risk.

Two of the most popular national programs designed to engage homeowners and communities in collectively preparing for wildfire and reducing risks are the Firewise Communities Program (Firewise) and Community Wildfire Protection Plans (CWPPs). The Firewise program encourages local solutions for reducing wildfire risks by involving homeowners in taking individual responsibility for risk reduction around their homes and property. Today there are more than 1,028 recognized Firewise communities (Firewise.org 2015). These communities obtain a wildfire risk assessment, develop an action plan that guides their residential risk reduction activities, and must invest a minimum of $2 per capita in local Firewise actions. Firewise actions help reduce the wildfire risks to homes and property, and include things like planting fire resistant plants, removing dead vegetation, pruning trees up six to ten feet from the ground, spacing trees and removing vegetation that is touching the house, using non-flammable construction materials, and developing an wildfire response plan (Firewise.org 2015).

A Community Wildfire Protection Plan (CWPP) is a collaborative plan created by a fire department, land managers, community leaders, and the public. The planning process maps values at risk and requires actions to reduce risk, such as prescribed burning, fuel reduction, or other measures that adapt a community to better confront their wildfire threat (Society for American Foresters 2004). Through the Healthy Forests Restoration Act (HFRA), communities

have an opportunity to influence where and how federal agencies implement fuel reduction projects on federal lands and how additional federal funds may be distributed for projects on nonfederal lands. Communities with CWPPs in place are given priority for funding of hazardous fuels reduction projects carried out under the HFRA (Society for American Foresters 2004).

CWPPs can take a variety of forms, based on the needs of the people involved in their development, and may address issues such as wildfire response, hazard mitigation, community preparedness, and structure protection. The process of developing a CWPP can help a community clarify and refine its priorities for the protection of life, property, and critical infrastructure in the WUI. Plans typically involve protecting community assets in WUI areas by reducing fuels, creating fuel breaks, and upgrading building construction. Most fire managers believe CWPPs are an essential component to reducing wildfire risks and costs, however some claim the success of CWPPs is mixed. While studies have shown CWPPs to be effective in increasing wildfire preparedness and prioritizing hazardous fuel treatments, other studies have found CWPPs have not resulted in sufficient reductions in risk (Ager et al. 2015).

Realization of the importance of individual homeowners in reducing wildfire threats has led to a growing interest in understanding what factors influence homeowners' decisions regarding whether or not to implement wildfire mitigation activities. An analysis of the findings from the central Oregon homeowner survey is informative for several reasons. First, it provides an opportunity to compare homeowners in one fire-prone region to those residing in other study areas, thereby adding to the collective knowledge about homeowner behavior and wildfire risk. Second, it can provide valuable information to regional fire managers regarding what actions homeowners are engaging in and which factors are their primary sources of motivation. Third, the findings from the survey can be used to craft policy solutions that encourage greater engagement in firewise activities by homeowners in the region, thereby reducing the overall wildfire risk faced by central Oregon communities. With so much at stake, and homeowners having the ability to play such a crucial role in minimizing wildfire risks and costs, a clearer understanding of homeowner behavior is necessary for developing effective wildfire management programs and policies that are tailored to unique regions.

Literature Review

Social Science Research and Private Homeowners

Federal efforts aimed at preventing wildfires are increasing their emphasis on private land and homeowners. Over the years, numerous government education and financial assistance programs have emerged to encourage homeowner mitigation activities as fire reduction strategies around the home have been proven to reduce the likelihood of homes lost to wildfire (Dombeck et al. 2004). Actions homeowners can take may vary by region, but recommendations for central Oregon homeowners in the WUI include building with fire-resistant materials, reducing vegetation within 30 feet of home, removing flammable debris, cleaning gutters, and locating firewood and propane away from structures (Project Wildfire 2007). Such actions are consistent with those recommended by the Firewise Communities Program, and may be referred to simply as "firewise" behaviors.

Prior to 2000, the majority of wildfire research was related to physical and ecological aspects of fire, however in recent years there has been a growing body of research aimed at understanding the social and human dimensions of wildfire (McCaffrey et al. 2013). In a review of the existing wildfire social science literature, Toman et al. (2013) identified 242 wildfire social science articles which they categorized according to five themes: 1) community/homeowner mitigation- 84 articles, 2) public acceptance of fuels treatments on public lands- 83 articles, 3) homeowner behaviors during fire and perceptions of fire management practices- 41 articles, 4) post fire response and recovery- 32 articles, and 5) wildland fire policy and planning- 69 articles. The first theme, community/homeowner mitigation, encompasses studies which examine actions taken by individual property owners and communities to reduce the threat of fire impacts, and including topics such as adoption of risk reduction behaviors, factors influencing adoption, barriers to adoption, and responsibility for mitigation on private property. This paper attempts to add to this body of work by investigating the motivating factors for firewise behavior in central Oregon homeowners.

The social aspects of wildfire are now recognized as an integral component of any successful wildfire management strategy. Benefits of understanding the social characteristics of wildfire include aiding land managers and policy makers in assessing wildfire risks and local capacity, directing limited resources to where they will have the biggest impact, and uncovering

the specific elements of social context that lead to wildfire mitigation behaviors (Paveglio et al. 2012).

Paveglio et al. (2011) found that the threat of wildfire is a very salient issue among WUI residents in the Inland Northwest. They also found participants believed fire was an inevitable reality, focus should be placed on reducing fire danger, and that individuals were responsible for reducing fire danger on their personal property. Nelson et al. (2004) concluded that landowners' mitigation decisions involve a trade-off between assessment of risk and landscape preferences. They identified naturalness, aesthetics, privacy, and recreation to be among the factors that impact decisions about fire mitigation behaviors.

A term being used to describe communities that are well-prepared for encountering a wildfire is "fire-adapted community". Abrams et al. (2015) define a fire-adapted community as one that can collectively plan for, mitigate or recover from, and adapt to changing wildfire events without losing function or sustaining significant loss of life and property. A fire-adapted community is one that is both prepared for a wildfire event and has the ability to recover from a wildfire event without significant hardship or reliance on external support. Getting private homeowners to engage in fire mitigation behavior is a critical component of becoming a fire-adapted community and reducing the risks and costs of wildfire in the future (Paveglio et al. 2012).

Another term used to describe communities that have reduced their risk and increased their ability to recover from a wildfire is adaptive capacity. Pertaining to wildfire, adaptive capacity can be defined as individual or collective resources, capabilities, and actions that alleviate risks or lessen impacts (Paveglio et al. 2012). It involves a combination of local and social characteristics that have a major influence on whether individuals or communities take action to reduce vulnerability or increase resilience to wildfire. Paveglio et al. (2012) concluded that adaptive capacity for dealing with wildfire is an undervalued component of community resilience and can aid larger discussions of wildfire management. Paveglio et al. (2009) found adaptive capacity to wildfire to be a function of (1) demographic characteristics, (2) local knowledge and experience, (3) access to scientific and technical knowledge, and (4) informal interactions and relationships among residents.

Engaging homeowners in firewise behaviors is a central component of local adaptive capacity and creating fire-adapted communities because, collectively, homeowner actions play an important role in reducing wildfire dangers, preventing property damage and loss of life, and conserving limited financial resources (Brenkert-Smith et al. 2012). Therefore, it's beneficial to know what factors influence homeowners' decisions to engage in wildfire mitigation. A better understanding of the factors related to individual mitigation behaviors by WUI homeowners can improve the success of wildfire education and outreach efforts (McCaffrey et al. 2013). Changing the behaviors of private homeowners in the WUI is also recognized as one of the best opportunities to decrease the amount of resources being spent on fire suppression (Dombeck et al. 2004). It is important that WUI homeowners engage in mitigation behavior because current government expenditures on wildfire and taking resources away from wildfire prevention activities such as fuels mitigation and community preparedness, thereby creating a negative feedback loop that increases future wildfire severity and risks (Brenkert-Smith et al. 2012).

Factors Influencing Homeowner Mitigation

Social science research suggests a number of factors influence private homeowners' decisions on whether or not to engage in wildfire mitigation behaviors. These include perceived risk, personal knowledge, sense of place, self-efficacy, perception of risk, personal preferences, presence of community initiatives, informal social interactions, relationships with neighbors, and past experience with hazards (McCaffrey et al. 2011; Brenkert-Smith et al. 2012). A 2013 article published by McCaffrey et al. in *International Journal of Wildland Fire* reviewed the available social science literature on wildland fire. They reported that decisions by homeowners to engage in fire mitigation strategies are influenced by the interaction of several factors including social context, trade-offs with other values, perceived effectiveness of mitigation, and capacity to engage in mitigation strategies. Others have found amenity values, institutional incentives, access to resources, and place dependency to affect personal decision-making (Brenkert–Smith et al. 2006; Collins and Bolin 2009).

Personal knowledge of wildfire risk and mitigation strategies is an important determinant of engaging in mitigation behavior, but knowledge alone does not ensure that homeowners' will engage in mitigation behaviors. Kyle et al. (2010) found that WUI residents are very knowledgeable and aware about defensible space activities but do not fully implement them. Weisshaupt et al. (2007) found knowledge levels and notions of responsibility varied among

participants and user groups in the WUI, but reported a general consensus that ultimately individuals are responsible for mitigating fire risk on their personal property. In addition, Paveglio et al. (2011) found that wildfire has a high level of salience for WUI residents in the Northwest and they possess a high level of understanding about wildfire, but decisions to mitigate are affected by complex decision-making processes involving many factors and preferences, some of them competing and requiring trade-offs.

In a study of Canadian homeowners, it was found that perceived risk had the greatest effect on mitigation (McFarlane et al. 2011). However, perceived risks from wildfire have not shown a consistent association with mitigation. Champ et al. (2013) concluded that risk perception alone was not responsible for mitigation, but rather mitigation behavior and risk perception are jointly determined and influenced by factors such as age, gender, and previous fire experience (Brenkert-Smith et al. 2012). By empirical analysis, Brenkert-Smith et al. (2012) found perceived risk and perceived effectiveness to be two factors most associated with mitigation, but McGee (2005) found no association between perceived risk of wildfire and number of mitigation actions taken by homeowners.

Interestingly, McFarlane et al. (2011) found that individual mitigation decisions and perceived risk are affected by the expected benefits and costs of mitigation. They suggest that homeowners adjust their perception of risk by weighing costs and benefits. This is in line with research by McCaffrey (2004) that determined WUI residents are generally aware of wildfire risks but are willing to accept these risks because of the benefits of living there. Nonetheless, it is unlikely that absent regulations homeowners would voluntarily invest time or resources into mitigation behavior if they do not believe some level of risk exists. The physical and financial ability to engage in mitigation behavior has also been found to influence homeowners in the WUI. MacFarlane et al. (2011) found that homeowners tend to adopt low cost, low effort options, and that lack of financial resources was a leading factor influencing homeowner mitigation decisions.

Social interactions and information sources are also key factors influencing fire mitigation behavior. Brenkert-Smith et al. (2012) found that information from experts and formal social interactions, as well as non-expert information and informal interactions, were all associated with perceived risk of wildfire. Non-expert sources of wildfire information include

neighbors, friends, family, and neighborhood groups. Brenkert-Smith et al. (2013) found that the social environment influences the way individuals think about fire and its potential impacts, and information exchanged in informal one-on-one interactions increases acceptance of the need for wildfire risk mitigation. Brenkert-Smith et al. (2006) found that informal social interactions were important to initiating personal mitigation behaviors.

Brenkert-Smith et al. (2013) also found that talking with one's neighbors was strongly associated with perceived probability of experiencing a wildfire, and found a positive association between information from neighbors and the perceived probability and consequences of wildfire. Previous research has also shown that neighbors' approval or disapproval influences the likelihood of taking action to reduce risk. Contrary to this and other findings, Bright and Burtz (2006) found that more individualistic residents were not influenced by neighbors or community expectations.

Brenkert-Smith (2010) determined informal social processes are important to risk mitigation and neighbors can serve as examples to one another. The biophysical nature of wildfire also makes neighbors important because failure to engage in hazard reduction at home sites can increase wildfire risks for surrounding homes. Because fire doesn't recognize property lines, there exists a high degree of risk interdependency among neighbors which is greater than in other types of natural hazards. Homeowners' perceptions of risk have been found to be higher when they believe neighboring properties are at a high risk of fire (Brenkert-Smith et al. 2012).

Findings from the central Oregon homeowner survey present an opportunity to better understand motivating factors for engaging in firewise activities for homeowners in one fire-prone region. The data set it generated provides an excellent opportunity to look at motivations and behaviors of WUI residents in central Oregon. Findings from this research will add to the larger discussion taking place about the behavior of homeowners living in wildfire-prone landscapes, provide regional fire managers with a better understanding of homeowners in six central Oregon counties, and can help inform policy solutions for reducing wildfire risks in this region.

Policy Theory

This research and inquiry was guided by theoretical principles and assumptions of the Social-Ecological Theory, commonly applied in the field of public health. The field of social ecology emerged in the 1960s and 1970s and gave attention to the social, institutional, and cultural contexts of people-environment relations (Stokols 1996). It emerged, in part, in response to the recognition that most public health challenges are too complex to be understood through a single level of analysis and instead require more comprehensive approaches that integrate multiple perspectives (Stokols 1996). A key feature of social-ecological models is they incorporate two or more analytical levels (e.g. personal, organizational, community). When considering all of the factors influencing the behavior of homeowners living in wildfire-prone landscapes (i.e. personal attributes, social networks, local regulations) a guiding theory that encourages one to broaden their perspective to include many of the different influences on personal behavior is beneficial.

The Social-Ecological Theory can be viewed as an overarching framework useful for understanding the relationships among diverse personal and environmental factors affecting an individual (Stokols 1996). It offers a theoretical framework for understanding the dynamic interplay among persons, groups, and their social and physical systems, offers a variety of conceptual tools, and can be used to develop practical guidelines for designing, implementing, or evaluating programs (Stokols 1996). Core assumptions of social ecological analyses are: 1) multiple physical, social, and cultural dimensions can influence behavioral outcomes; 2) personal and situational factors interact with one another; and 3) the same factors may affect people differently (Stokols 1996).

Creating fire-adapted communities implies reducing wildfire hazards and promoting community safety and well-being and therefore is similar to promoting

community health. Stokols (1996) defines community health promotion as emphasizing collaborative efforts among various public and private sectors to enhance well-being of a population within a geographically defined area. The strategies used in thinking about public health promotion are similar to those for reducing wildfire hazards: environmental strategies that have the capacity to benefit all persons rather than focusing on one person at a time can have a greater overall impact. For example, a forest that is thinned or treated with a prescribed burn will reduce the risks of all the nearby homeowners and can have a great impact than treating one home at a time.

Limitations on fostering behavioral changes in individuals are similar in public health and wildfire mitigation and consist of economic, social and cultural constraints. Lack of education, limited resources, motivation, self-efficacy, influence of neighbors, and social networks can influence one's efforts and intentions in both fields. Social-ecological theories do have weaknesses, however. They assume that the best models must be all-encompassing, but it is difficult to include every conceivable variable. Such approaches may neglect individual and group differences, making results too broad to be useful in a local context.

Methods

Data

The data used in this study was taken from the *Public Attitudes toward Wildfire in Central Oregon* homeowner survey conducted between February and April of 2011. The survey was administered to a random sample of 1,704 residing in the wildland–urban interface households in Crook, Deschutes, Jefferson, Klamath, Lake, and Wasco Counties of central Oregon. Census tracts intersecting with a half-mile buffer surrounding lands managed by the US Forest Service and Bureau of Land Management were identified, and names and addresses of residents were then drawn from census blocks. The buffer was identified using ArcGIS software, and the names and addresses of residents within the identified census blocks were provided by a commercial research company (n = 1704).

A modified Dillman (2000) design method was used to administer the survey. First, a postcard was mailed to the sample households notifying them that they would be receiving a survey in the coming weeks. Next, the survey was mailed with a cover letter explaining the purpose of the survey and instructions for completion and returning in the accompanying prepaid

envelope. This was followed by a second mailing of the survey, cover letter, and prepaid enveloped to survey non-respondents. Five hundred and thirty-two responses were received, a response rate of 31 percent. Recipients were asked to respond to a variety of questions concerning demographics, information sources, wildfire risk, wildfire mitigation behaviors, and experience with wildfire. The survey is divided into two sections, with a total of 25 questions (Appendix 1).

Table 1: Characteristics of survey respondents

Characteristic	Survey Respondents
Mean Age	57.3 (range: 24-86)
Gender	Female = 40.9%, Male = 59.1%
Associate's degree or higher	44.3%
Household Mean Income	$50,000-$74,999 (mean category = 4.1)
Homeownership Rate (2009-2013)	89.47%
Participation Rate	Survey response rate: 31%

Source: Public Attitudes toward Wildfire Survey, 2011.

Many of the surveys that were received included missing responses for certain questions or entire survey sections. The firewise model used in this research includes a total of 247 of the households that returned the survey because incomplete surveys were excluded. While this resulted in a smaller than desired sample size, it ensured that every respondent included in the model had completed all of the questions used in the model and therefore no assumptions were made regarding their answers. The information presented in Table 1 displays characteristics of survey respondents. The mean age for a respondent in this survey is 57.3 years, nearly sixty percent of respondents are male, and forty-three percent of the respondents have obtained an associate's degree or higher. The homeownership rate is very high among respondents, with almost 90 percent reporting that they own their home. Slightly less than one-third of households responded to the survey.

Description of Central Oregon Study Area

Six counties in central Oregon were selected for this study (Crook, Deschutes, Jefferson, Klamath, Lake, and Wasco). Together, these counties have a population of approximately 314,000, but a relatively small population density due to the large land mass these counties encompass (Project Wildfire 2007). The natural environment of central Oregon is characterized by Lodgepole Pine, Ponderosa and Juniper forests and rangeland ecosystems, all of which are historically fire-dependent (Project Wildfire 2007). This region lies in the rain shadow of the

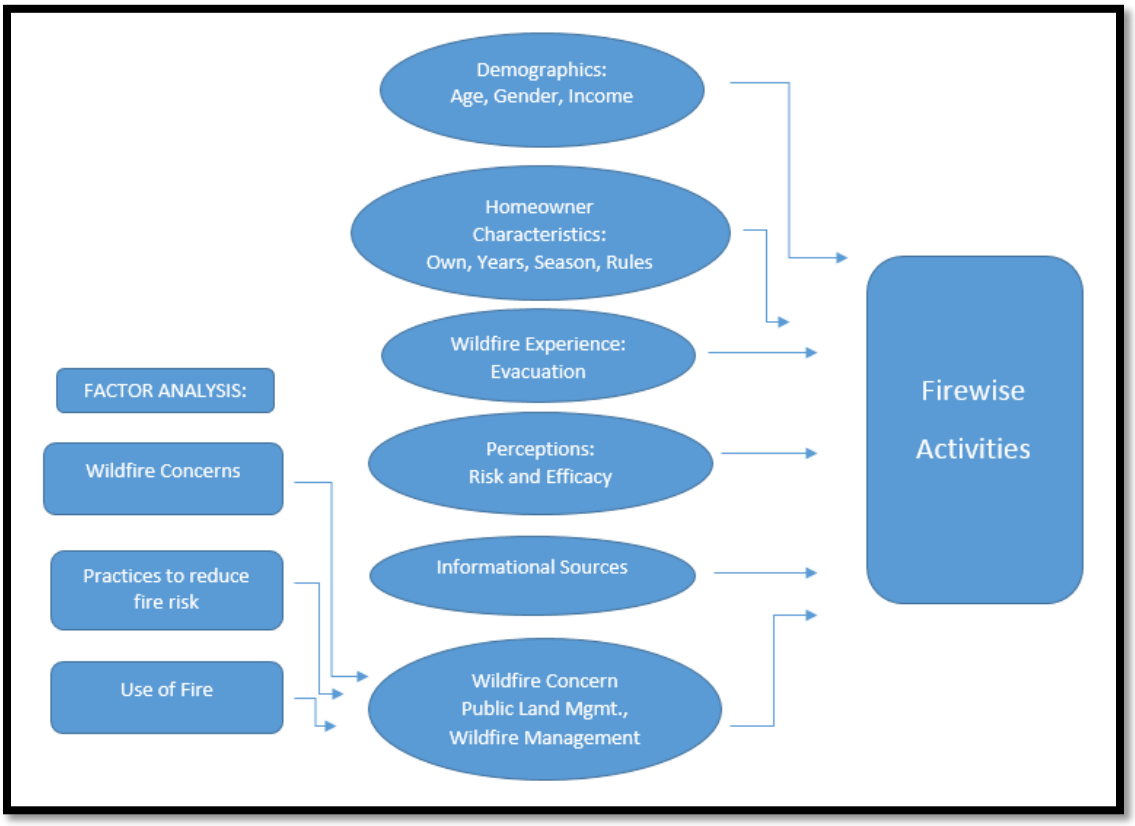
Cascade mountain range, creating a dry and sunny climate. A lack of precipitation, high summer temperatures, and lightning storms result in frequent wildfires. The frequency of wildfires and proximity of many communities to fire-prone environments make central Oregon counties a prime target for research on homeowner wildfire mitigation.

Building a Behavioral Model

Based on the literature regarding homeowner wildfire mitigation, mitigation behavior is a function of demographic characteristics, risk perception, perceived efficacy of actions, past wildfire experience, sources of wildfire information, and other characteristics of home ownership. A new category of variables which seeks to measure individuals' primary concerns regarding wildfire and opinions of public land and wildfire management was included in this research to test the relationships between these variables and wildfire mitigation (see Figure 2). These variables were generated using a series of factor analyses, the process and justification of which will be described later in this section. It is suspected that these variables will be shown to have an impact on homeowners' decisions to engage in wildfire mitigation behavior in addition to, or perhaps in place of, other variables in the model. The model was developed based on theory and the authors' intuition about several variables that have to yet to be included in this type of behavioral model.

Daniel (2007) proposed that perceptions and reactions to wildfire differ depending on the biophysical setting, social-demographics, and one's socio-cultural background. A more thorough analysis of homeowner mitigation would account for as many influencing factors as possible, including the biophysical condition both on and adjacent to one's property. However, while the biophysical condition would impact wildfire behavior and the biophysical risk, its impact on individual behavior is likely to be mediated by one's perception of risk. Therefore, this model assumes perception of risk to be a better predictor of one's actions than the actual biophysical risk, even while perception is a likely impacted by biophysical setting. This model also accounts for several demographic variables that previous research has shown to be associated with wildfire mitigation. The variables created from the factor analyses are believed to account for some aspects of socio-cultural background. That is to say, one's opinions on wildfire and public land management, as well as their environmental preferences, are impacted at least in part by their socio-cultural background.

Figure 2: Model of firewise behavior



Analytical Methods

Ordinary Least Squares (OLS) is a form of regression analysis that uses sample data to estimate the true relationship between variables. OLS is a widely used technique for understanding the relationship among a variable of interest (the dependent variable) and a number of other variables (independent variables). If done properly, it can be used to infer causal relationships between the variables, but it is important to distinguish between causation and correlation – that is, a correlation between two variables does not necessarily imply that changes in one variable cause changes seen in another variable. In this analysis, OLS is used to determine which variables are significantly correlated with changes in firewise scores, as well as the direction and magnitude of those changes. To put another way, OLS is used to discover the impact that certain variables are having on firewise activity in this cohort of central Oregon homeowners.

Factor analysis is a data reduction technique based on the assumption that variation observed in individual variables reflects patterns of a smaller number of some deeper and more

fundamental features, or "factors" (Acton et al. 2009). It is useful for uncovering patterns in data when confronted with entangled behavior, unknown interdependencies, and large numbers of variables (Rummel 1967). A factor analysis may be used to untangle the linear relationships among variables and group them according to patterns, where each pattern appears as a factor delineating a distinct cluster of interrelated data (Rummel 1967). Essentially, it groups interdependent variables into descriptive categories with similar characteristics.

Factors are defined by looking at the salient loadings from the variables and then assigning a descriptive name that portrays this meaning. Factor scores are standardized, meaning they will have a mean of zero and a standard deviation of 1. They are useful because they are, in effect, scales of the variables from which they are constructed and can be presumed to be more reliable than any one of the individual variables (Acton et al. 2009). Incorporating the factors as new variables in an OLS regression moves into the realm of "latent variable analysis", where these unobserved variables are argued to be better representations of reality than the original variables themselves (Acton et al. 2009). Latent variables are not directly observed; rather, they are inferred using a mathematical model from other variables that are observed, and as such are sometimes referred to as hidden variables. One advantage of using latent variables is that a large number of observable variables can be aggregated into fewer underlying concepts, possibly making the data easier to comprehend.

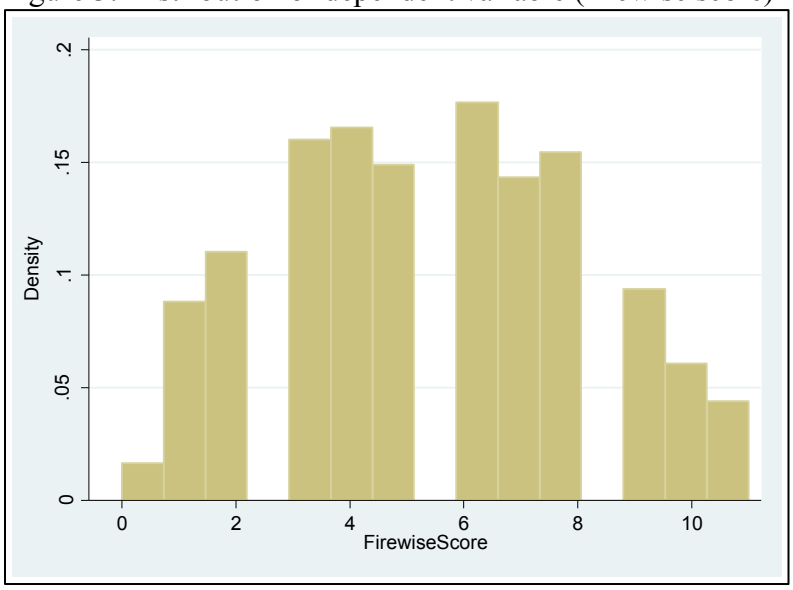
The delineation of these interrelated variables enables generalizations to be made and hypotheses posed about the underlying influences bringing about the relationships (Rummel 1967). Each of the variables analyzed is mathematically related to the factor patterns. A factor analysis first produces factors that define general patterns of relationship in the data. The factors are then subjected to a method of rotation (in this case an Orthogonal Varimax Rotation was used) to delineate distinct clusters of relationships if they exist. The loadings and factor scores describing the patterning of the data are found by the analysis, and once patterns are determined a descriptive label can be attached (Rummel 1967). Factor loadings indicate how each hidden factor is associated with the observable variables used in the analysis.

Measure of Firewise

The dependent variable used in this analysis was a measure of firewise actions, with higher values implying that individuals completed more actions. The variable was generated by

summing the number of firewise activities (0 to 11) that a homeowner completed, with equal weight given to each of the eleven activities. The values for the dependent variable are normally distributed, with a mean of 5.5 and a standard deviation of 2.7 (see Figure 3). Assuming a normal distribution, about 68 percent of homeowners in the survey have completed between 2.8 and 8.2 of the firewise actions (within the range of one standard deviation).

Figure 3: Distribution of dependent variable (firewise score)



Independent Variables

The independent variables included in this model were based on a review of the relevant social science research relating to wildfire mitigation behavior. Similar to the approach used by Brenkert-Smith et al. (2012), variables were chosen that represent five categories: demographic characteristics, risk perception, wildfire experience, perceived efficacy of actions, and information sources. Additional variables were added to account for homeowner characteristics that have been shown to influence firewise behavior, such as the length of time one has lived in a wildfire prone area and whether they rent or own their home. Finally, an additional category of variables was added to the model in an attempt to measure the effect of one's primary wildfire concerns and feelings toward public land and wildfire management. These variables were generated using a series of factor analyses where the leading principal components were defined and included as an independent variable, in line with the approach described by Acton et al. (2009). A description and summary measures for independent variables are presented in Table 2.

Table 2: Independent variables

Variable	Variable Description	Mean (SD)
Efficacy	Whether one believes firewise actions reduce their wildfire risk, 0 = no, 1 = yes	0.87
PreviousEvac	Dummy variable for previous evacuation due to wildfire, 0 = no, 1 = yes	0.03 (0.17)
ChanceFireClose	Chance of fire occurring in forests close to one's home or property, 1 = zero percent to 11 = 100 percent	7.88 (2.76)
ChanceFireDamage	Chance of fire causing damage to one's home or property if fire occurred in forests close to one's home, 1 = zero percent to 11 = 100 percent	4.03 (2.93)
Seasonal	Permanent or seasonal home, 1 = permanent, 2 = seasonal	1.01
YrsAtResidence	Years living at residence, Range: 0.5 - 56	12.39 (10.52)
OwnVsRent	Whether one owns or rents their home, 1 = own, 2 = rent	1.11
Age	Respondent age in years, Range: 24-86	57.28 (13.61)
Gender	Dummy variable for respondent gender, 0 = female, 1 = male,	0.59
Income	Respondent annual income, 1 = < $15,000 to 6 = >$100,000	4.06 (1.44)
InfoFamily	Whether respondent seeks advice or receives assistance about firewise from this group, 0 = no, 1 = yes	0.36
InfoNeighbor	Whether respondent seeks advice or receives assistance about firewise from this group, 0 = no, 1 = yes	0.3
InfoLocalFire	Whether respondent seeks advice or receives assistance about firewise from this group, 0 = no, 1 = yes	0.44
InfoODF	Whether respondent seeks advice or receives assistance about firewise from this group, 0 = no, 1 = yes	0.21
InfoUSFS	Whether respondent seeks advice or receives assistance about firewise from this group, 0 = no, 1 = yes	0.34

Generating and Interpreting the Factors

Five of the variables included in the model were created by taking the leading factors from three distinct factor analyses using survey questions. The intent behind using the factor analysis technique was to create variables that were not directly measured by just one question in the survey, such as wildfire concern. The first factor analysis was conducted on a series of questions regarding concern about the risks presented by wildfire to private property, fish and wildlife habitat, and timber resources on public lands. The leading two factors were retained and included in the OLS model, and given descriptive names assumed to accurately capture the underlying driver of variability in the data. In this case, TimberConcern (concern for timber

resources) and PrivPropConcern (concern for private property) were the two variables retained, given titles thought to infer their meaning. In the case of TimberConcern, the factor explains 23 percent of the variability of responses for the questions measuring wildfire concern, and it was given that name because the three underlying questions "loading" highly onto this particular factor are related to concern for timber resources (see Table 3).

Once included in the model, interpretation of the factors should be treated differently than the other variables because interpreting precisely what the factors are measuring, or the scale of the factors, cannot be done with certainty. In this model, it is assumed that a significant value for the beta coefficient of a factor variable implies there is a correlation between the factor and firewise score. However, it is difficult to imply what a one unit change in the scale of the factor means for firewise score. Thus, the results are best interpreted as positive or negative relationships between factors and firewise score, with the magnitude of the beta coefficients possibly suggesting a stronger impact on firewise score.

Table 3: Factor analysis of questions measuring concern about private property, habitat, and timber resources relating to wildfire, prescribed fire, and fuel treatments to reduce wildfire severity

Factor	% Var. Explained	Dominant Variables	Variable Loading
TimberConcern	23.0%	Economic Loss of Usable Timber due to managing wildfire	+0.8909
		Economic loss of usable timber due to prescribed fire	+0.8525
		Economic use of useable timber on public lands due to wildfire	+0.7339
PrivPropConcern	17.9%	Damage to private property due to managing wildfire	+0.7418
		Damage to private property due to prescribed fire	+0.7214
		Acceptability of Managing Wildfire around neighborhoods	-0.6845

The second factor analysis was generated using questions relating to support for practices intended to reduce flammable fuels and the risk of high severity wildfire on public lands. Specifically, the questions asked about support for prescribed fire, managing wildfires, and thinning to reduce hazard fuels both around neighborhoods and in remote forest areas. The results of this factor analysis generated two leading factors included in the OLS model: ProThinning and ProFireUse, assumed to be measuring support for the use of thinning public

forests to reduced wildfire risks and support for the use of prescribed and managed fires, respectively (see Table 4).

Table 4: Factor analysis of questions measuring acceptability of practices to reduce fuels and wildfire severity on public lands

Factor	% Var. Explained	Dominant Variables	Variable Loading
ProThinning	33.7%	Acceptability of Thinning in remote forests	+0.8364
		Acceptability of Thinning around neighborhoods	+0.7901
		Prescribed fire in remote areas	+0.6839
ProFireUse	29.7%	Monitoring and managing wildfire around neighborhoods	+0.8917
		Monitoring and managing wildfire in remote forests	+0.6872
		Prescribed fire around neighborhoods	-0.6091

The final factor analysis generated one factor that was included in the model. In this case, the factor analysis included seven questions measuring concern for the possible effects of wildfire. The leading factor, EnvrConcern, is assumed to measure concern for damage to the environment from wildfire, specifically damages to fish and wildlife habitat, scenic quality, and diminished recreational opportunities (see Table 5).

Table 5: Factor analysis of questions about concern over the possible effects of wildfire

Factor	% Var. Explained	Dominant Variables	Variable Loading
EnvrConcern	74.7%	Loss of Fish and Wildlife Habitat	+0.7623
		Lost or diminished recreational opportunities	+0.7151
		Overall Reduced Scenic Quality	+0.6709

Results and Discussion

The model includes twenty independent variables, five of which are dummy variables indicating where homeowners receive information about wildfire mitigation and preparedness. Ten other variables were selected based on previous research, which has shown them to be

significant determinants of wildfire mitigation behavior, and were described in the literature review. These variables include perceived efficacy, previous evacuation experience, two measure of perceived risk (chance of wildfire occurring close to home and chance of wildfire causing damage to home if it occurred nearby), whether one owns or rents their home, whether they live there seasonally or year-round, and the number of years at their current residence. Three demographic variables were also included – age, gender, and income level. The results of the model are presented in *Table 6.*

Five variables were created and added to the model by taking the leading principal component(s) from three separate factor analyses using a series of questions regarding concerns about wildfire and preferences for public land and wildfire management. These variables are TimberConcern (measuring level of concern for timber resources damaged by wildfire), PrivPropConcern (measuring level of concern for private property damaged by wildfire), ProThinning (measuring level of support for thinning to reduce wildfire risks), ProFireUse (measuring level of support for using prescribed fire and managing wildfires for resource benefits), and EnvrConcern (measuring concern for loss of ecosystem services, scenic quality, and recreational opportunities due to wildfire). The model suggests that four of the five factor variables are significantly correlated with firewise scores. Interpreting the values for the beta coefficients of the factors, however, is best done in general terms for reasons previously described.

Demographics and Homeowner Characteristics

In this model, age, gender and income are the only demographic characteristics included, of which only income was found to have a significant (90% level) effect on wildfire mitigation behavior. A beta coefficient of -0.26 indicates that each increase in aggregate income level (of which there are 6), is correlated with completing 0.26 fewer firewise actions. This suggests that wealthier individuals engage in fewer firewise activities, which is somewhat contrary to previous assumptions about the effect of income on personal mitigation. While income has only a slight impact on firewise score between similar income brackets in this model, the aggregate impact of income between the lowest and highest income brackets is equal to 1.3, suggesting that the lowest income individuals in the survey may be completing 1.3 additional firewise activities than the wealthiest individuals. Previous research has shown that financial constraints can prevent

some individuals from undertaking firewise mitigation activities (Toman et al. 2013), however this model demonstrates a negative relationship between income level and firewise.

The model also controls for whether one rents or owns their home, whether the resident lives at their residence seasonally or year-round, and the number of years they have lived at their current residence. Previous research has shown that all of these variables influence firewise behavior (McCaffrey et al. 2013). Previous research has also shown that seasonal residents and renters may complete fewer firewise activities than those who own their homes and reside their year-round. This research supports the assumption that renters indeed engage in fewer firewise activities. In this model, renters are correlated with completing 1.0 fewer firewise actions than those who own their homes (95% confidence level). However, the model did not show a significant correlation between either seasonality of residence or length of time and firewise score. Previous research has also shown that individuals who live in a neighborhood association with firewise landscaping rules engage in more firewise actions, however due to the high number of individuals (~25%) in the survey who answered that they did not know whether such rules existed in their neighborhood, this variable was excluded from the model.

Factors Associated with Mitigation

The variables shown to have the biggest impact on firewise activity are perceived efficacy of actions and previous evacuation experience due to wildfire and these results are consistent with the literature. The beta coefficient for Efficacy is 2.38 and it is highly significant at the 99% confidence level. If an individual believes the actions they implemented will be effective at reducing their wildfire risk, they are associated with completing approximately 2.4 additional firewise actions compared to those who do not believe their actions will be effective. If an individual has been evacuated due to wildfire in the past, they are associated with implementing 1.81 additional activities, significant at 95% confidence level. These two variables alone are correlated with an additional 4.1 firewise actions, providing further evidence of the importance of perceived efficacy and previous wildfire experience on engaging in firewise behaviors around the home and property.

Table 6: Firewise model with factors

Source	SS	df	MS		
Model	741.321717	20	37.0660858	Number of obs =	247
Residual	1087.89286	226	4.81368521	F(20, 226) =	7.70
				Prob > F =	0.0000
Total	1829.21457	246	7.43583161	R-squared =	0.4053
				Adj R-squared =	0.3526
				Root MSE =	2.194

FirewiseScore	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Efficacy	2.381813	.4526849	5.26	0.000	1.48979	3.273836
PreviousEvac	1.811893	.8241862	2.20	0.029	.1878205	3.435965
ChanceFireClose	-.1308711	.0535041	-2.45	0.015	-.2363017	-.0254404
ChanceFireDamage	.0399995	.0509835	0.78	0.434	-.0604644	.1404634
Seasonal	-1.667766	1.611007	-1.04	0.302	-4.842282	1.50675
YrsAtResidence	.0136795	.014756	0.93	0.355	-.0153975	.0427565
OwnVsRent	-1.046808	.5292287	-1.98	0.049	-2.089662	-.0039548
Age	.0001272	.0123141	0.01	0.992	-.0241379	.0243923
Gender	.101623	.3191874	0.32	0.750	-.5273409	.7305869
Income	-.2560141	.1105029	-2.32	0.021	-.4737619	-.0382663
InfoFamily	.0467156	.3200671	0.15	0.884	-.5839818	.677413
InfoNeighbor	.2744534	.3369247	0.81	0.416	-.3894622	.938369
InfoLocalFire	1.23298	.3241888	3.80	0.000	.5941606	1.871799
InfoODF	.7149676	.4113306	1.74	0.084	-.095566	1.525501
InfoUSFS	.4734124	.370985	1.28	0.203	-.2576194	1.204444
TimberConcern	.5011178	.1676248	2.99	0.003	.1708104	.8314252
PrivPropConcern	1.087494	.4973866	2.19	0.030	.1073857	2.067602
ProThinning	-.5036003	.4448502	-1.13	0.259	-1.380185	.3729843
ProFireUse	-.4107521	.1653875	-2.48	0.014	-.7366507	-.0848534
EnvrConcern	-.5803797	.3458458	-1.68	0.095	-1.261875	.1011151
_cons	6.881551	2.037499	3.38	0.001	2.866625	10.89648

Because risk perception is positively correlated with firewise behavior, this model includes two measures: chance of wildfire close to one's home (ChanceFireClose) and the likelihood that if fire occurred nearby it would damage one's home or property (ChanceFireDamage). Only the first of these variables was shown to be positively correlated with firewise, and the beta coefficient of -0.13 (95% confidence level) suggests that for each increase in risk perception (measured as a percentage from zero to 100 percent in 10 percent intervals) there is a slight (-0.13) decrease in actions completed. The results of the model suggest that an individual who perceives the lowest risk of wildfire occurring near their home or property is correlated with completing as many as 1.3 additional firewise activities compared to an individual who perceives the highest risk of wildfire occurring nearby. This result is contrary to both previous research suggesting risk perception is positively correlated with wildfire mitigation and to what one might rationally assume would be the effect of higher levels of risk perception on firewise.

When the factor variables were excluded from the model, ChanceFireDamage becomes significant and suggests that increased risk perception of wildfire actually causing damage to one's home or property if it were to occur in forests near one's home is correlated with higher firewise scores (see Table 7). This shift could be related to one of the factors – PrivPropConcern – which measures concern for wildfire causing damage to private property. Looking at the results from both models suggests that perceived risk of fire occurring has the opposite effect of perceived risk of damage occurring from wildfire and concern for private property damage caused by wildfire. It is not whether one believes fire will occur that increases firewise score, but belief or concern that when fire occurs it will cause damage to property.

The chance of wildfire doing damage to one's home or property were it to occur nearby (ChanceFireDamage) was not significantly correlated with firewise. It was expected that believing there is a risk of damage from wildfire occurring nearby would be correlated with an increase in firewise activity. However, the lack of correlation shown in this model may be explained by the fact that the two measures of risk perception are correlated with one another (r value equal to 0.23). However, when either variable was removed from the model, it resulted in changes to the beta coefficients and significance levels of other variables in the model, suggesting that both variables needed to be retained or the model would suffer from omitted variable bias. One possible explanation for the difference in the impact of these two measures of risk perception on firewise score may be explained by the order of their relationship with firewise. If one perceives a high risk of wildfire occurring nearby, they may engage in more firewise activities, thus lowering their perceived risk of wildfire causing damage *because* they have undertaken the additional firewise activities. Explanations aside, perceived risk of wildfire occurring nearby is correlated with completing more firewise actions, while perceived risk of wildfire doing damage is not.

Another topic of interest is which sources of information about personal wildfire mitigation are correlated with firewise scores. Of the five dummy variables measuring where an individual receives information about wildfire mitigation, only two – Local Fire Department and Oregon Department of Forestry (ODF) – were significantly correlated with higher firewise scores. Receiving information from one's local fire department is correlated with the highest increase in firewise score. A beta coefficient of 1.23 (significant at the 99% confidence level),

suggests that local fire departments' are not only the most impactful source of wildfire mitigation information, but it may be beneficial for other entities to encourage firewise behavior by using local fire departments as the primary disseminators of information. Receiving information from ODF is correlated with completing 0.71 additional firewise activities (90% confidence level), suggesting that the state agency assigned responsibility for fire protection of state and private forests is another impactful source of information about wildfire mitigation for homeowners in central Oregon.

It is also interesting to consider which sources of information were not correlated with firewise scores. Family members, neighbors, and the US Forest Service (USFS) were not significant determinants of firewise activity in this model. This runs contrary to previous research by Brenkert-Smith et al. (2013) and others who have shown that talking with one's neighbors about wildfire often leads to increased firewise activity. Other research by Brenkert-Smith (2010) found that information from experts and social interactions influence fire mitigation behavior, however this research suggests that the receiving information for USFS, despite their expertise in fire prevention and management, is not having a significant impact on firewise activity in this group of homeowners, nor is receiving information from family members. It is possible that the method these entities use to disseminate information about wildfire mitigation and the level of trust individuals have in these information sources are better predictors of the impact the information has on firewise than the actual content of the information (Shindler 2007).

Factor Analysis-Generated Variables

Of the five variables generated using a factor analysis and included in the OLS model, four were found to be significantly correlated with firewise score. This was a primary area of interest because attitudes toward public lands and wildfire management have yet to be included in this type of firewise behavior model. It was thought, for instance, that concern for environmental values such as fish and wildlife habitat and scenic views, or holding the opinion that forests should be more actively managed for fire prevention, could be determinants of firewise behavior. The results of this research suggest that this is indeed correct – certain feelings toward land and wildfire management are correlated with firewise behavior.

The decision to include these "factor variables" in the model was tested by running a comparable model that did not include the factors (see Table 7). When these factor variables are excluded from the model there are changes in the beta coefficients and significance levels for other variables, suggesting that without these factor variables the model does suffer from omitted variable bias (this was confirmed using a Ramsey Reset test in Stata). Including the factor variables also increased the R-squared value by approximately five percentage points, suggesting the model does a better job of explaining the variability in firewise score with their inclusion.

Four of the five factor variables are significantly correlated with firewise score (the only factor variable not correlated with firewise is ProThinning). The first factor variable, TimberConcern, has a beta coefficient of 0.50 (99% confidence level), suggesting a positive correlation between concern for timber resources damaged by wildfire and firewise score. Beyond making a general assertion of the directionality of the relationship between being concerned about damage to timber resources from wildfire and firewise score, it is difficult to interpret the results of the beta coefficient. Because the scale of the factor variables are composites of underlying variables, it is difficult to assign a meaningful unit of measurement to TimberConcern, and it is therefore difficult to predict its impact on firewise across its range of values. Because the scale of the factor variables in unknown, there is no way to say what a one unit increase in TimberConcern is, and therefore difficult to predict its impact on firewise across its range of values. It may be accurate to assert that as level of concern for damage to timber resources increases, so too will firewise score. But for the purposes of this paper, the results focus on the direction of the correlation (i.e. positive vs. negative). For example, the variable PrivPropConcern has a beta coefficient of 1.09 (95% confidence level), suggesting there is a significant positive correlation between concern for damage to private property from wildfire and completing firewise actions. The higher magnitude of the beta coefficient may also suggest that the relative impact of concern for private property on firewise score is greater than concern for timber resources, but again this is difficult to say for sure without a better understanding of the relative scale of the factors.

Support for the use of fire (ProFireUse) in regard to forest and wildfire management is significantly correlated with firewise score, but the relationship is negative. This factor has a beta coefficient of -0.41 (95% confidence level), suggesting that support for fire use is correlated

with fewer firewise actions. Likewise, EnvrConcern is negatively correlated with firewise score. This variable is assumed to measure concern for damage caused by wildfire to fish and wildlife habitat, recreational opportunities, and scenic quality; essentially it is measuring concern for the environment and maybe be thought of as representing a "pro-environment" opinion. This variable had a beta coefficient of -0.58 (90% confidence level). One might infer from these results that that those of the pro-environment and pro-fire use persuasions choose to complete fewer firewise actions.

The correlation of EnvrConcern with lower firewise scores may be because many firewise activities involve removing brush, thinning vegetation, and other activities that one of the pro-environmental persuasion may not want to do. Previous research has shown that wildfire mitigation decisions around the home involve tradeoffs; one such tradeoff is between a preference for naturalness around the home and wildfire mitigation. That desire for naturalness might also extend to the forests adjacent to one's home and property. Concerning support for the use of fire, the three variables with the highest loadings onto this factor were support for managing wildfire both adjacent to neighborhoods and in distant forests, as well as support for the use of prescribed fire adjacent to neighborhoods.

There is widely considered to be lack of support by the general public for managing wildfire and prescribed burning, especially near communities, and this lack of support is a primary reason why greater use of fire to achieve resource benefits does not occur. This factor suggests that there are individuals who support fire use in central Oregon, and that those individuals are completing slightly fewer firewise actions. It could be that this group of homeowners prefers that tools such as prescribed and managed wildfire be used to reduce wildfire risks because they would rather not adopt certain firewise actions. Their support might also be related to the level of trust they have in fire professional to use fire for resource benefits, even in close proximity to neighborhoods, to help reduce wildfire risks, but this reason fails to explain the negative correlation with firewise score.

Table 7: Firewise model without factors added

Source	SS	df	MS	Number of obs =	247
				F(15, 231) =	8.35
Model	643.320687	15	42.8880458	Prob > F =	0.0000
Residual	1185.89389	231	5.13373978	R-squared =	0.3517
				Adj R-squared =	0.3096
Total	1829.21457	246	7.43583161	Root MSE =	2.2658

FirewiseScore	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Efficacy	2.71429	.4547156	5.97	0.000	1.81837	3.61021
PreviousEvac	2.13489	.8428287	2.53	0.012	.4742758	3.795504
ChanceFireClose	-.1014837	.0536261	-1.89	0.060	-.2071425	.004175
ChanceFireDamage	.1111007	.0472655	2.35	0.020	.0179741	.2042274
Seasonal	-1.590631	1.647779	-0.97	0.335	-4.837228	1.655967
YrsAtResidence	.0149685	.0150671	0.99	0.322	-.0147179	.044655
OwnVsRent	-1.006427	.5440988	-1.85	0.066	-2.078457	.0656038
Age	-.0009216	.0124508	-0.07	0.941	-.0254532	.0236101
Gender	.119735	.3225258	0.37	0.711	-.5157333	.7552033
Income	-.183309	.1114382	-1.64	0.101	-.4028742	.0362561
InfoFamily	.0884457	.3270896	0.27	0.787	-.5560146	.732906
InfoNeighbor	.4514435	.3427096	1.32	0.189	-.2237926	1.12668
InfoLocalFire	1.381337	.3264567	4.23	0.000	.7381235	2.02455
InfoODF	.7308551	.418547	1.75	0.082	-.0938025	1.555513
InfoUSFS	.4318132	.3744284	1.15	0.250	-.3059181	1.169544
_cons	5.531302	2.065704	2.68	0.008	1.461273	9.601331

Policy Section

Wildfire Policy Problem

Wildfire in the western US poses a serious and complex policy problem. Historical fire management policies that prioritized fire suppression have created unnatural forest conditions characterized by excess fuel loads. This biophysical condition, aided by prolonged droughts and other factors has led to increasingly large and severe wildfires that threaten ecosystems and human communities. These wildfires destroy natural resource commodities, burn homes and structures, put lives at risk, and dramatically increase firefighting costs. The problem is compounded by continued rapid growth in the wildland-urban interface (WUI), legal rulings and policies that have reduced the amount of timber cut on federal lands, a lack of public support for the widespread use of prescribed fire, and fire budgets that continue to emphasize firefighting at the expense of prevention and mitigation.

Without policy changes, wildfire risks will remain high, wildfire costs will continue to grow, and the most cost-effective strategies to reduce future wildfire problems will remain underfunded. Some researchers believe the high levels of wildfire risk today are the negative consequences of a positive feedback loop in wildfire management (Calkin et al. 2015). Calkin et

al. (2015) suggest that there is substantial pressure on federal agencies to continue "the century old policy of aggressive wildfire suppression", even though wildfire suppression is a major reasons for the increased size, intensity, and damage associated those large wildfires that are unable to be suppressed. Thus, despite facing unprecedented wildfire risks and costs, these risks drive demand for more fire suppression, thereby increasing wildfire risks in the future. As fire historian Stephen Pyne writes, every fire put out in a city is a problem solved; every fire put out in a wildland is a problem put off (Pyne 2015).

Carroll et al. (2007) state that changes to ecosystems resulting from over a century of fire suppression and land management practices cannot be undone across entire landscapes in a short time frame. They contend that the long-term horizon required to undue these ecosystem changes is incomprehensible to a political system notorious for its impatience and suggest that the interaction of the biophysical and sociopolitical issues across varied landscapes, jurisdictions, and timescales makes wildfire a classic "wicked" environmental problem (Carroll et al. 2007). Wicked environmental problems are those comprised of multiple, overlapping, and interconnected subsets of problems that cut across multiple policy domains and levels of government (Weber and Khademian 2008). In the case of wildfire, fire management is inescapably connected to other issues such as land-use planning, public land management, environmental protection, and economic development. Wildfire management also engages conflicting values, such as the desire for reducing shared risks and individual property rights, and generates high degrees of uncertainty, all consistent with Weber and Khademian's (2008) description of wicked environmental problems.

Developing policy solutions to solve a wicked environmental problem over a century in the making and driven by a positive feedback loop which increases the level of risk on an annual basis is no easy task. Many fire policy experts suggest that solutions must move beyond the traditional boundaries of wildfire policy. Mutch et al. (2011) suggest that clear and effective policies are needed to address land management and conservation concerns in the changing landscapes of the WUI. Such policies, they argue, would integrate aspects of land use planning, land management, urban design, community education, and fire agency activities, while acknowledging community values (Mutch et al. 2011). Such thinking suggests that fire policy,

to be effective, must move beyond the boundaries of traditional fire policy concerns to address issues of private land management.

The complexity of the wildfire problem and its multiple drivers suggests that wildfire policy needs to address the problem simultaneously on multiple fronts, confront the challenges presented by land-use and growth in the WUI, and do a better job of encouraging wildfire mitigation by homeowners and achieving fire-adapted communities. This will require substantially larger short-term investments to undue conditions created by a century's worth of policy and management. This research focused on homeowners and the factors contributing to engagement in firewise activities around their homes and properties, but the policy recommendations offered move beyond a focus on just Oregon homeowners in attempt to acknowledge the interconnectedness of forest health, land use, homeowner mitigation, and other factors.

Proposed Legislation

Several pieces of legislation to address today's wildfire problem have been proposed in the 114th US Congress. The following three bills highlight some of the different policy solutions proposed at the federal level. First, the Wildfire Disaster Funding Act of 2015 (S. 235) proposes to change the way the US Forest Service (USFS) funds wildfire suppression. By drawing from disaster and emergency accounts whenever wildfire suppression costs exceed 70 percent of the 10-year average cost of wildfire suppression, the attempts to ensure that funds for wildfire prevention activities in the nation's forests won't need to be used for suppression (Sen. Wyden 2015) . The National Fire Plan (NPF) passed by Congress in 2001 identified four priority areas for wildfire funding: (1) Firefighting and Suppression, (2) Forest Restoration, (3) Hazardous Fuels Reduction, and (4) Community Assistance. Contrary to the goals the NPF, the vast majority of funding has gone toward fire suppression, followed by fuels reduction, leaving only a small amount of funds available for restoration or community assistance (Steelman and Burke 2007). Changing the way the federal government funds wildfire suppression could mean that other policy objectives, such as community preparedness and forest restoration, will be better funded in the future.

The Resilient Federal Forests Act (H.R. 2647) would allow the Federal Emergency Management Agency (FEMA) to cover wildfire costs once all other suppression funding is

exhausted (prevent fire-borrowing), allow for expedited environmental reviews for hazardous fuel removal and other forest projects, and protect collaborative projects from delay by requiring binding for would-be litigants (Rep. Westerman 2015). It would also make it more difficult to issue a lawsuit against the Forest Service by requiring plaintiffs who lose lawsuits to pay for the agency's legal expenses, and in some cases by exempting the agency from paying the plaintiff's legal expenses if the plaintiff wins**.** Environmental groups criticize the bill for attempting to increase logging by undermining the National Environmental Policy Act, reducing citizen opportunities to seek judicial relief, and reallocating funds away from road maintenance and restoration activities to timber projects (Earthjustice 2015). The bill represents the sentiments of many Republican members of Congress who insist that increasing timber harvests and fuel reduction activities on federal lands is a key component of reducing wildfire risk. While this could reduce both wildfire risks and suppression costs, the political reality is that such proposals are unlikely to be passed under the Obama administration, especially given the lack of support for such activities among many conservation groups and segments of the general public.

Finally, the Wildfire Management Act of 2015 (yet to be introduced) would attempt to lower the frequency of large wildfires, reduce the number of homes lost to wildfires, restore fire to ecosystem processes, and increase post-fire community assistance (Staff for Senator Maria Cantwell 2015). The bill would have the largest fires paid out of FEMA's Disaster Relief Fund, authorize up to $300 million annually specifically for conducting controlled burns on federal, state, and private lands, and authorize $1 billion for reducing hazardous fuels (up from $350 million per year). The bill would also provide financial assistance to counties for developing land-use ordinances and other fire-related planning, provide financial incentives to prioritize development in lower fire risk areas, and provide incentives for communities to move away from constructing new homes with cedar shake roofs (Staff for Senator Maria Cantwell 2015). It would direct the Forest Service to draft model codes requiring homeowners to adopt best practices for mitigating fire damage for use by local governments that choose to adopt them. The bill would also require the federal government to work with states to develop detailed maps that define areas with high risk from fires. This bill is the most comprehensive of any in the 114th US Congress, incorporating significant increases in funding for fuel reduction and prescribed fire with policies related to land-use planning, building codes, and homeowner mitigation.

Wildfire Policy Recommendations

One of the challenges of wildfire social science is how to turn research findings into policy recommendations that are socially acceptable, politically feasible, and a specific enough to generate positive benefits for wildfire management. To begin the process of generating useful policy recommendations, the first step is to decide on the desired outcome of such policies. In this case, it is assumed that the outcome is to achieve a sustainable coexistence with fire, one in which fire is allowed to burn in a manner that maximizes the benefits of wildfire without putting communities, lives and resources at risk (Abrams et al. 2015). Recent fire years suggest that society is a long way from achieving such a coexistence with fire, but it may be getting closer to understanding and accepting what creating this coexistence would entail.

Because the majority of damages to homes and communities occurs in the wildland-urban interface, and the bulk of firefighting expenditures goes to defending homes and communities when fires cannot be suppressed, improving community wildfire mitigation would reduce both property losses and the firefighting costs. But part of achieving fire-adapted communities must also involve changing how the forests and rangelands around those communities are managed. A lack of mitigation by many homeowners, and a lack of the political will to force them to adopt such behaviors through laws and regulations, means that reducing risks in the surrounding wildlands is critical to reducing risks to communities. A home where the owner has not adequately mitigated the fire risk will require greater protection from firefighters (Syphard et al. 2014). It is also likely to benefit from treatment to lands around the home to reduce the risk of fire transmission. Whether these lands are public or private will each illicit different policy responses, as well as opposition.

The results of this research suggest a number of strategies that can be useful to fire managers and policymakers. However, they will work best when accompanied by regulatory mechanisms or financial incentives that encourage land-use planning, community wildfire preparedness, firewise building codes, and homeowner mitigation and are accompanied by significant increases in short-term funding for forest restoration and fuel treatments. These investments in forest restoration should embrace a collaborative approach where local stakeholders, fire manager, community leaders, and land agencies develop and implement forest management plans in conjunction with community wildfire protection plans and efforts to encourage firewise behavior by homeowners.

This research confirms previous findings which suggest that perceived efficacy has one of the biggest impacts on firewise behavior. The challenge is to convince homeowners of both the need to engage in firewise activities to reduce their risk to wildfire while also convincing them that their actions will be effective. Providing information is one way to educate the public about the importance of wildfire mitigation, however it is wrong to assume that educating the public automatically leads to changes in behavior. Shindler (2007) suggests that while technical information is useful, information alone is not enough to change people's behavior. Further, research has shown that trust in the source of the information and the manner by which it is conveyed are the predictors of successful use of that information than content alone (Shindler 2007). Technical and financial assistance are likely more appropriate ways to encourage firewise behavior then providing general information about wildfire mitigation programs because it can improve the capacity of individuals to act.

Regarding information sources, this research suggests that local fire departments and the Oregon Department of Forestry (ODF) are the best sources of information for promoting firewise activity. This research did not explore the reasons why these sources are correlated with higher firewise scores, but it does suggest that future attempts to promote wildfire risk mitigation by homeowners would benefit from using these entities as the disseminators of information. The US Forest Service should evaluate its approach to informing homeowners' about wildfire mitigation and compare its approach with local fire departments and ODF in order to understand the differences that may exist related to content, process, or some other factor such as public trust in the organization.

An important shortcoming of this research is that it treats all homeowners the same. That is, it does not clearly account for community and cultural differences that are likely to significantly impact firewise. For example, a homeowner in the suburbs of Bend is not differentiated in this study from a homeowner in rural Klamath County, despite political and cultural differences that exist in the different locations. But it may be that these differences are captured in part by the factor variables assumed to measure wildfire concern and opinions on land and wildfire management. This research found, for example, that concern about wildfire's impact on private property and timber resources are correlated with higher firewise scores. It also suggests a negative correlation between individuals concerned about wildfire's impact on

environmental values and firewise activity. The question, then, is what can be inferred from these results and how is it useful to policymakers and fire professionals? While the answers may be hard to extract from this research alone, it could suggest that one's political persuasion and environmental values are accurate predictors of firewise activity. Further research could look at where these individuals are clustered and what specific firewise actions they are completing, and that knowledge could potentially lead to a better understanding of how to encourage them to complete additional actions.

This research also suggests there could be a benefit in targeting greater resources toward those individuals who are renting their homes. Previous research has shown that those who rent their homes are less likely to engage in firewise activities, and this research confirmed those results. Targeting fire prevention resources specifically at those who rent their homes and adopting regulations requiring minimum firewise mitigation around rental homes could be successful strategies for reducing risks around these rental homes.

While this research has identified a number of possible strategies for encouraging firewise mitigation by homeowners in central Oregon, it is unlikely that such an approach will achieve the goal of fire-adapted communities without increased financial investments and regulatory mechanisms. Other research has demonstrated that the location of a home or neighborhood is an important predictor of wildfire risk, even if the homes are firewise (Syphard et al. 2012), which underscores the importance of land-use planning to reduce wildfire risks, particularly in the WUI. Zoning and planning authority generally rests with state and local governments, so it will likely require effort at the state level to ensure that communities throughout various WUI locations undertake land-use planning efforts aimed at reducing future wildfire risks. States can do this by providing financial incentives for communities to integrate wildfire planning into land-use plans or by mandating that communities in wild-fire prone landscapes adopt a locally-crafted and state-approved Community Wildfire Protection Plans.

States can also mandate or incentivize certain building codes in the WUI to reduce the risks of home ignition in a wildfire event. Stephens et al. (2009) compared Australian and Californian approaches to managing fire in the wildland-urban interface and concluded that California could reduce losses in WUI wildfires by improving building codes, encouraging local ordinances that mandate defensible space and fire-resistant materials in home construction, and

provide subsidies for improvements which create more fire-resilient homes. A recognition that wildfire events will continue to occur on certain landscapes and that the majority of home ignitions are caused by embers rather than contact with the actual fire front reveals the need for policies that mandate or create incentives for building with fire-resistant materials in high wildfire risk locations.

Federal efforts to change how the US Forest Service pays for the largest wildfires is only a first step. At the federal level, policymakers should also fund a massive investment in fuel-reduction in areas at a high or very high risk of catastrophic wildfire. Policymakers and fire managers must also find ways to increase their tolerance for risk and foster social acceptability of prescribed and managed fire. Greater emphasis should be placed on cost-share opportunities with state and local entities to help leverage federal funds and increase the level of investment by those communities and states most threatened by the impacts of wildfire. Creating policies at the state level that encourage or mandate wildfire land-use planning, firewise building codes, CWPPs, and homeowner mitigation would be a game-changer in combatting the growing wildfire problem. The federal government could pressure state and community action by tying certain federal funding, including post-fire assistance, to having certain fire plans and building codes in place. It could also provide federal fire managers with the option of withholding firefighting resources if communities have not completed a CWPP or a home clearly isn't firewise. Regardless of whether it is a carrot or a stick approach, something needs to be done to incentivize more wildfire risk mitigation at state and local levels in concert with efforts to reduce the biophysical wildfire risks. Adopting legislation with many of the concepts contained within the Wildfire Management Act of 2015 would be a good start.

Conclusions

The data analyzed in this study provides insight into the complexity of homeowner decision-making associated with wildfire mitigation. Several factors which the literature suggests are determinants of wildfire mitigation behavior were found to be highly significant factors in this model, while other factors were shown to have little impact on firewise behavior. This study also introduced a new category of variables into the behavioral model- wildfire concern and opinions of public land and wildfire management, four of which were found to be significantly correlated with firewise. This study confirms some previous research on the factors influencing

homeowner behavior in the WUI, contradicts other research, and adds a new dimension to thinking about what factors influence wildfire mitigation decisions. These findings could be tested in a similar study involving a different population of homeowners in another wildfire-prone region of the western US, and this data could be analyzed further by exploring the spatial relationships that. Of particular interest to this author would be continued research into the effects that opinions of public land and wildfire management, as well as environmental values, have on firewise mitigation and what spatial similarities exist among homeowners in this central Oregon study area.

While this research focused on the factors affecting firewise activity in homeowners residing in central Oregon counties, the intent was to offer a broader picture of the wildfire problem in the western US and potential solutions. Homeowners are a critical part of solving this problem and reducing risks to lives and resources, but they are just one part of a larger puzzle. The latest numbers from the Pacific Northwest show that the state of Oregon spent over $120 million dollars on wildfire protection in 2015, more than two and a half time its base budget (Oregon Department of Forestry 2015). In the Pacific Northwest, the US Forest Service spent nearly $1 billion on wildfire related activities, yet was not able to prevent hundreds of homes and over a million acres burning (Roman 2015). All of the resources spent on fighting wildfires consume public funds that could be used to fulfill other policy goals, from education to healthcare to improving forest health, which suggests that solving the wildfire problem could actually help solve other societal problems as well.

Bibliography

Abrams JB, Knapp M, Paveglio TB, Ellison A, Moseley C, Nielsen-Pincus M, Carroll MS. 2015. Re-envisioning community-wildfire relations in the US West as adaptive governance. Ecol. Soc. 20:34.

Abrams J, Paveglio T, Moseley C, Knapp M, Ellison A, Nielsen-Pincus M. 2015. Community experiences with wildfire: actions, effectiveness, impacts, and trends: results from two surveys in counties and communities affected by wildfire.

Acton C, Miller R, Maltby J, Fullerton D. 2009. Factor Analysis. In: SPSS for Social Scientists. 2nd Ed. New York, NY: Palgrave Macmillan. p. 241–255.

Ager AA, Kline JD, Fischer AP. 2015. Coupling the Biophysical and Social Dimensions of Wildfire Risk to Improve Wildfire Mitigation Planning: Coupling the Biophysical and Social Dimensions of Wildfire Risk. Risk Anal. 35:1393–1406.

Austin A, Salay L. 2012 Sep 12. New CoreLogic Report Reveals Wildfires Pose Risk to More Than 740,000 Western U.S. Homes. [accessed 2013 Nov 25]. http://www.corelogic.com/about-us/news/new-corelogic-report-reveals-wildfires-pose-risk-to-more-than-740,000-western-u.s.-homes.aspx

Brenkert-Smith H. 2010. Building bridges to fight fire: the role of informal social interactions in six Colorado wildland–urban interface communities. Int. J. Wildland Fire 19:689–697.

Brenkert–Smith H, Champ PA, Flores N. 2006. Insights Into Wildfire Mitigation Decisions Among Wildland–Urban Interface Residents. Soc. Nat. Resour. 19:759–768.

Brenkert-Smith H, Champ PA, Flores N. 2012. Trying Not to Get Burned: Understanding Homeowners' Wildfire Risk–Mitigation Behaviors. Environ. Manage. 50:1139–1151.

Brenkert-Smith H, Dickinson KL, Champ PA, Flores N. 2013. Social Amplification of Wildfire Risk: The Role of Social Interactions and Information Sources. Risk Anal. 33:800–817.

Bright AD, Burtz RT. 2006. Creating Defensible Space in the Wildland–Urban Interface: The Influence of Values on Perceptions and Behavior. Environ. Manage. 37:170–185.

Burton L. 2013. Wildfire mitigation law in the Mountain States of the American West: a comparative assessment. [accessed 2015 Oct 13]. http://www.ucdenver.edu/academics/colleges/SPA/Research/EAWG/Research/wildfires/Documents/WhtPprIntrstStdy15jul13.pdf

Busenberg G. 2004. Wildfire Management in the United States: The Evolution of a Policy Failure. Rev. Policy Res. 21:145–156.

Calkin DE, Thompson MP, Finney MA. 2015. Negative consequences of positive feedbacks in US wildfire management. For. Ecosyst. 2. [accessed 2015 Oct 30]. http://www.forestecosyst.com/content/2/1/9

Carroll MS, Blatner KA, Cohn PJ, Morgan T. 2007. Managing fire danger in the forests of the US inland Northwest: A classic "Wicked problem" in public land policy. J. For. 105:239–244.

Collins TW, Bolin B. 2009. Situating Hazard Vulnerability: People's Negotiations with Wildfire Environments in the U.S. Southwest. Environ. Manage. 44:441–455.

Daniel TC. 2007. Perceptions of Wildfire Risk. In: People, fire, and forests: a synthesis of wildfire social science. Corvallis: Oregon State University Press. p. 55–69.

Dellasala DA, Williams JE, Williams CD, Franklin JF. 2004. Beyond smoke and mirrors: a synthesis of fire policy and science. Conserv. Biol. 18:976–986.

Dillman DA. 2000. Mail and internet surveys: The tailored design method (Vol. 2). New York: Wiley.

Dombeck MP, Williams JE, Wood CA. 2004. Wildfire policy and public lands: Integrating scientific understanding with social concerns across landscapes. Conserv. Biol. 18:883–889.

EarthJustice. 2015. Our public forest lands are under attack. [accessed 2015 Dec 1]. http://earthjustice.org/blog/2015-july/our-public-forest-lands-are-under-attack

Firewise.org. 2015. The basics of defensible space and the "home ignition zone." [accessed 2015 Oct 17]. http://www.firewise.org/wildfire-preparedness/be-firewise/home-and-landscape/defensible-space.aspx

Forest and Rangelands. The Federal Land Assistance, Management and Enhancement Act of 2009: Report to Congress. [accessed 2015 Oct 21]. http://www.forestsandrangelands.gov/strategy/documents/reports/2_ReportToCongress03172011.pdf

GAO. 2015. Wildland Fire Management: Agencies Have Made Several Key Changes but Could Benefit from More Information about Effectiveness. Report No.: GAO - 15 - 772.

Gill AM, Stephens SL. 2009. Scientific and social challenges for the management of fire-prone wildland–urban interfaces. Environ. Res. Lett. 4:034014.

Gorte R. 2013. The Rising Cost of Wildfire Protection. Headwaters Economics.

Hammer RB, Stewart SI, Radeloff VC. 2009. Demographic Trends, the Wildland–Urban Interface, and Wildfire Management. Soc. Nat. Resour. 22:777–782.

Kyle GT, Theodori GL, Absher JD, Jun J. 2010. The Influence of Home and Community Attachment on Firewise Behavior. Soc. Nat. Resour. 23:1075–1092.

McCaffrey SM. 2004. Fighting fire with education: what is the best way to reach out to homeowners? J. For. 102:12–19.

McCaffrey SM, Stidham M, Toman E, Shindler B. 2011. Outreach Programs, Peer Pressure, and Common Sense: What Motivates Homeowners to Mitigate Wildfire Risk? Environ. Manage. 48:475–488.

McCaffrey S, Toman E, Stidham M, Shindler B. 2013. Social science research related to wildfire management: an overview of recent findings and future research needs. Int. J. Wildland Fire 22:15–24.

McFarlane BL, McGee TK, Faulkner H. 2011. Complexity of homeowner wildfire risk mitigation: an integration of hazard theories. Int. J. Wildland Fire 20:921–931.

McGee TK. 2005. Completion of recommended WUI fire mitigation measures within urban households in Edmonton, Canada. Glob. Environ. Change Part B Environ. Hazards 6:147–157.

Moritz MA, Batllori E, Bradstock RA, Gill AM, Handmer J, Hessburg PF, Leonard J, McCaffrey S, Odion DC, Schoennagel T, et al. 2014. Learning to coexist with wildfire. Nature 515:58–66.

Mutch RW, Rogers MJ, Stephens SL, Gill AM. 2011. Protecting Lives and Property in the Wildland–Urban Interface: Communities in Montana and Southern California Adopt Australian Paradigm. Fire Technol. 47:357–377.

North MP, Stephens SL. 2015. Reform Wildfire Management. INSIGHTS.

Paveglio TB, Carroll MS, Absher J, Robinson W. 2011. Symbolic Meanings of Wildland Fire: A Study of Residents in the U.S. Inland Northwest. Soc. Nat. Resour. 24:18–33.

Paveglio TB, Carroll MS, Jakes PJ, Prato T. 2012. Exploring the Social Characteristics of Adaptive Capacity for Wildfire: Insights from Flathead County, Montana. Hum. Ecol. Rev. 19:110–124.

Paveglio TB, Jakes PJ, Carroll MS, Williams DR. 2009. Understanding Social Complexity Within the Wildland–Urban Interface: A New Species of Human Habitation? Environ. Manage. 43:1085–1095.

Project Wildfire and the Central Oregon Fire Prevention Coop. 2007. Beyond the Flames: The Story of Wildfire in Central Oregon. [accessed 2013 Dec 2]. www.projectwildfire.org

Pyne SJ. 2015 Sep 3. Why Forest Fires Seem Like They Are Getting Out of Control. Hist. News Network. [accessed 2015 Dec 1]. http://historynewsnetwork.org/article/160521

Radeloff VC, Hammer RB, Stewart SI, Fried JS, Holcomb SS, McKeefry JF. 2005. The wildland–urban interface in the United States. Ecol. Appl. 15:799–805.

Rep. Westerman B [R-A-4]. 2015. H.R. 2647: Resilient Federal Forests Act of 2015. 114th US Congress.

Roman J. 2015. The Year in Wildfire. NFPA Journal.

Rummel RJ. 1967. Understanding Factor Analysis. J. Confl. Resolut. 11:444–480.

Sen. Wyden R [D-O.]. 2015. S. 235: Wildfire Disaster Funding Act of 2015. 114th US Congress.

Shindler B. 2007. Public acceptance of wildland fire conditions and fuel reduction practices: Challenges for federal forest managers. In: People, Fire and Forests: A Synthesis of Wildfire Social Science. Corvallis: Oregon State University Press. p. 37–54.

Society for American Foresters. 2004. Preparing a Community Wildfire Protection Plan. [accessed 2013 Nov 13]. https://www.safnet.org/lp/cwpphandbook.pdf

Staff for Senator Maria Cantwell. 2015. The Wildfire Management Act of 2015: A White Paper. [accessed 2015 Sep 27]. http;//wildfiretoday.com/.../WildfireManagementAct2015WhitePaper.pdf

Oregon Department of Forestry official. Nov 17, 2015. Update on 2015 Wildfire Season. Joint Ways and Means Interim Committee on Natural Resources. Salem, OR.

Steelman TA, Burke CA. 2007. Is wildfire policy in the United States sustainable? J. For. 105:67–72.

Stephens SL, Adams MA, Handmer J, Kearns FR, Leicester B, Leonard J, Moritz MA. 2009. Urban–wildland fires: how California and other regions of the US can learn from Australia. Environ. Res. Lett. 4:014010.

Stokols D. 1996. Translating social ecological theory into guidelines for community health promotion. Am. J. Health Promot. 10:282–298.

Syphard AD, Brennan TJ, Keeley JE. 2014. The role of defensible space for residential structure protection during wildfires. Int. J. Wildland Fire 23:1165.

Syphard AD, Keeley JE, Massada AB, Brennan TJ, Radeloff VC. 2012. Housing Arrangement and Location Determine the Likelihood of Housing Loss Due to Wildfire. Schumann GJ-P, editor. PLoS ONE 7:e33954.

Toman EL, Stidham M, McCaffrey S, Shindler B. 2013. Social science at the wildland-urban interface: A compendium of research results to create fire-adapted communities. US Department of Agriculture, Forest Service, Northern Research Station. [accessed 2015 Oct 1]. http://www.nrs.fs.fed.us/pubs/gtr/gtr_nrs111.pdf

USDA Forest Service. 2015. The Rising Cost of Wildfire Operations: Effects on the Forests Service's Non-Fire Work. [Accessed 2015 Nov 15]. http;//http://www.fs.fed.us/sites/default/files/2015-Fire-Budget-Report.pdf

Valentine K. 2013 Nov 22. More Than 4.5 Million U.S Homes Are At "High Or Extreme Risk" From Wildfires | ThinkProgress. [accessed 2013 Nov 25]. http://thinkprogress.org/climate/2013/11/22/2982711/wildfire-risk-homes/

Weber EP, Khademian AM. 2008. Wicked problems, knowledge challenges, and collaborative capacity builders in network settings. Public Adm. Rev. 68:334–349.

Weisshaupt BR, Jakes PJ, Carroll MS, Blatner KA. 2007. Northern inland west land/homeowner perceptions of fire risk and responsibility in the wildland-urban interface. Hum. Ecol. Rev. 14:177–187.

Western Forestry Leadership Coalition. 2010. The True Cost of Wildfire in the Western U.S. [accessed 2015 Dec 2]. http://http://www.wflccenter.org/news_pdf/324_pdf.pdf

Winter G, McCaffrey S, Vogt CA. 2009. The role of community policies in defensible space compliance. For. Policy Econ. 11:570–578.

Appendix:

Appendix 1: Wildfire Survey

Preliminary Results – October 2012

Public Attitudes Toward Wildfire

A Survey of Homeowners in Central and South-Central Oregon

School of Public Policy

300 Gilkey Hall

Oregon State University

Corvallis, Oregon 97331-6206

541-737-2811

The following are results for the Public Attitudes Toward Wildfire Survey conducted between July 2012 and September 2012. The survey was administered to a stratified random sample of 1,704 WUI households in Central and South-Central Oregon. Recipients were asked to respond to a variety of questions associated wildfire, wildfire risk, wildfire management, and experience with wildfire.

Preliminary findings for most questions are detailed below. Due to rounding, percentages may total between 99% and 101%. Also, open ended questions were omitted from the results.

Section 1

In this first section of the survey we ask some general questions about interests in, activities relating to, and knowledge of wildfire issues in Central Oregon.

Q-1. Wildfire may create concerns for some people. Please indicate how concerned you are about the following possible effects of wildfire in Central Oregon.

	Not a concern	Slight concern	Moderate concern	Great concern
Damage to your private property				
Lost or diminished recreational opportunities				
Loss of wildlife and fish habitat				
Uncontrolled and high severity wildfires				
Economic loss of useable timber on public land				
Overall reduced scenic quality				
Increased levels of smoke				

Q-2. Considering the forests closest to your home, in your opinion, **what is the chance of wildfire** of any severity in the next 5 years?

Percent Chance	Respondent Average
0%	
10%	
20%	

30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	
Don't know	

Q-3. If a wildfire were to occur in the forests closet to your home, in your opinion, what is the chance it would damage your property or home?

Percent Chance	Respondent Average
0%	
10%	
20%	
30%	
40%	
50%	
60%	
70%	
80%	
90%	
100%	
Don't know	

The following questions ask about specific practices resource managers use to reduce flammable fuels and the risk of wildfire in public forests and rangelands. The terms used are:

Prescribed fire: also called controlled burning, this practice involves intentionally setting ground fires to reduce forest fuels like grass, brush, and small trees.

Monitoring and managing wildfire: formerly called "let burn," this practice involves managing some wildfires by monitoring them and allowing them to burn in a way that achieves ecological objectives without undue risk of loss to property and life. This in in contrast to a wildfire that is automatically suppressed.

Thinning: using chainsaws or other machinery to reduce the number of small trees where they are so dense they increase the risk of wildfires.

Q-4. What is your opinion of using the following practices to reduce flammable fuels and the risk of high severity wildfire on public lands (e.g. National Forests)?

	Totally Unacceptable	Somewhat Unacceptable	Neutral	Somewhat Acceptable	Totally Acceptable	Don't Know
Prescribed fire:						
-- around						

neighborhoods						
-- in remote forest areas						
Monitoring and managing wildfire:						
-- around neighborhoods						
-- In remote forest areas						
Thinning:						
-- around neighborhoods						
-- In remote forest areas						

Q-5. The use of **prescribed fire** and **monitoring and managing wildfire** may create concerns for some people. Please indicate how concerned you are about the following possible effects for both prescribed fire and monitoring and managing wildfire in Central Oregon.

	Prescribed Fire				**Monitoring and Managing Wildfire**			
	Not a concern	Slight Concern	Moderate Concern	Great Concern	Not a Concern	Slight Concern	Moderate Concern	Great Concern
Damage to private property								
Loss or diminished recreational opportunities								
Loss of wildlife and fish habitat								
Risk of fire getting out of control								
Economic loss of useable timber								
Reduced scenic quality								
Increased levels of smoke								

Q-6. What is your opinion about **smoke from prescribed fire** and **monitoring and managing wildfire**?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

I am not concerned about smoke					
I think smoke levels are managed acceptably					
Smoke is acceptable if it results in healthier forests					
I worry about the effects on my personal or family health					
I worry about the effects of smoke on travel safety					

Q-7. Within the **last five years**, have any of the following occurred on your property or nearby **public or private lands**?

A wildfire occurred…	**Yes**	**No**	**Don't know**
on my property			
in my neighborhood			
just outside my neighborhood			
lands within several miles of me			
on lands within my watershed			
A controlled burn or prescribed fire occurred…			
on my property			
in my neighborhood			
just outside my neighborhood			
lands within several miles of me			
on lands within my watershed			
A tree insect infestation or tree disease outbreak occurred…			
on my property			
in my neighborhood			
just outside my neighborhood			
lands within several miles of me			
on lands within my watershed			
Invasive plant species became established…			
on my property			
in my neighborhood			
just outside my neighborhood			
lands within several miles of me			
on lands within my watershed			

Q-8. "**Firewise" activities** include planting fire-resistant plants, using non-flammable construction materials, pruning branches within 85 feet of your house, reducing the density of trees within 100 feet of the residence, as well as other activities to reduce fire risk near a home. Within the last five years, have you completed any "firewise" activities in the immediate vicinity of the residence?

Yes	

No	

Q-9. Now we would like to ask some more detailed questions about "firewise" activities and other actions for mitigating wildfire risk. Please indicate if you have participated in any of these activities or not in the last 5 years by circling "yes" or "no." If you did participate in the activity (answered "yes,") please indicate the possible reason(s) you did.

	Participated?	Reduces my risk	Required by state, county, neighbor-hood	Required by insurance	Received financial assistance to participate	Like the way it looks	Neighbor participated
General planning:	**Yes** **No**						
Prepare an evacuation plan for your home in case of wildfire							
Consider weather reports (e.g. moisture conditions) when planning recreational activities that involved fire (e.g. campfires, fireworks)							
Community activities:							
Attend community-based meetings related to wildfires							
Obtain information from a land management, community group or firefighting agency on how to prepare for wildfire							
Property protection activities:							
Plant fire-resistant plants							
Plant trees and shrubs at least 15 feet apart							
Prune the branches of trees within 85 feet of your home							
Reduce the density of trees within 100 feet of your home							

Home protection activities:							
Clean roof surfaces/gutters and surrounding vegetation to avoid accumulation of needles, leaves, and dead plants							
Stack firewood/lumber at least 30 feet from the home							
Use nonflammable building materials such as tile, slate, stone, etc.							

Q-10. Who do you receive information from, talk with, or seek advice from about <u>actions on your property</u> for reducing fire risk, or <u>making changes to your home</u> to improve fire safety? For each person/group listed below, indicate if/how you interact with this person. Use the blank spaces to add others we may have missed. If you need more space, please use the end of the survey. One example has been completed for you.

Person/Group	Do you talk with or seek advice or receive assistance from this person/ group?		How **frequently**?				How much do you **trust** the information you get from this person/group?				How **important** is the information you get from this person/group to your decision?			
			Never	Occasionally	Often	Frequently	None	Limited	Moderate	Full	Not	Slightly	Moderately	Very
	% N	% Y	%	%	%	%	%	%	%	%	%	%	%	%
Family member														
Neighbor														
Neighborhood association														
Local fire department														

Local fire awareness group (Project Wildfire, Firefree, etc.)				
Local collaborative group (Lakeview Stewardship Group, etc.)				
City or county government				
University extension agent				
Oregon Department of Forestry				
Natural Resources Conservation Service (Soil Conservation Service)				
The Nature Conservancy				
U.S. Forest Service				
Other:_____ _____				
Other:_____ _____				

Section 2

The final section of the survey asks a few concluding questions to check to see if our survey is representative of all types of people.

Q-11. Is the property this survey is addressed to your permanent or seasonal/vacation home?

Permanent Residence	
Seasonal/vacation home	

Q-12. How long have you lived in Central Oregon?

Live in Central Oregon		
Don't live in Central Oregon		

Q-13. How long have you lived in this Central Oregon residence?

Q-14. How much land do you have at this Central Oregon address?

Q-15. Do you own or rent this property?

Own	
Rent	

Q-15a. In what year did you become the owner of this home?

Q-15b. How did you acquire this home?

Purchased from a stranger	
Purchased from a friend/acquaintance	
Purchased from a family member or inherited	
Received as a gift/inherited	
Other	

Q-15c. Which of the following factors (if any) influenced your decision to become a homeowner in Central Oregon?

	Yes	**No**
Natural amenities		
Recreation opportunities		
Employment opportunities		
Cost of land relative to elsewhere		
For timber, agriculture, or ranching opportunities		
Land investment opportunities		
I've always lived here		
Family landholding		
To be near family		
Other		

Q-16. Is the neighboring property developed with a structure or undeveloped?

Developed with a structure	
Undeveloped	
Both	

Q-17. Does your homeowners' association or subdivision have rules about landscaping or building materials in your area to help protect against fires?

Yes	
No	
Don't Know	
I don't live in a homeowners' association	

Q-18. How close is your home in Central Oregon to a wildland area (either forest or rangeland)?

Live within a wildland area	
Adjacent to a wildland area	
Between 100 and 300 yards	
More than 300 yards but less than 1 mile	
Between 1 and 3 miles	
More than 3 miles	

Q-19. Were you evacuated (voluntary or mandatory) due to wildfire in the past five years?

Yes	
No	

Q-20. What is your age?

Mean	

Q-21. Please indicate your gender?

Male	
Female	

Q-22. What is the highest level of education you have completed?

Junior high school or less	
Some high school	
High School or GED	
Associate's degree, technical school or some college	
Bachelor's degree	
Master's, doctoral, or professional degree	

Q-23. Do you or anyone in your family rely on any of the following for income?

	Yes	**No**
Natural Resources		
Agriculture		
Service-based industry		

Recreation		

Q-24. What is your annual household income before taxes?

Less than $15,000	
$15,000 to $24,999	
$25,000 to $49,999	
$50,000 to $74,999	
$75,000 to $99,999	
$100,000 or more	

Q-25. Does anyone in your household suffer from a respiratory ailment?

Yes	
No	