Exploring Temporal Phases of Wildfire Adaptation: Experiences Across Socially Diverse Communities

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Authorization to Submit Dissertation

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Abstract

The increasing frequency and size of wildfire events across the United States and their subsequent impacts on populations living in fire-prone landscapes indicate an urgent need to strengthen community efforts to adapt to fire. Communities in the wildland-urban interface may take vastly different approaches to address wildfire risk, complicating the adoption and implementation of many policy and management efforts. Developing a stronger understanding of how varying community-wildfire interactions may change and evolve over time can offer insights about the enduring social legacies of wildfire risk and their implications for wildfire management. This dissertation presents three studies in four different communities across the Western United States designed to investigate social dimensions of wildfire before, during, and after wildfire events, including: (1) Community recovery and extra-local assistance after a large fire; (2) The influence of pre-fire and event-based cues on intended evacuation behavior; and (3) Support for regulatory approaches to wildfire risk reduction in two rural communities. I use a range of qualitative and quantitative methods to explore how communities can or are adapting to wildfire at different 'phases' in the duration of a wildfire's lifespan. Each chapter concludes with several implications or recommendations for wildfire risk management in the wildland-urban interface. These efforts can inform proactive approaches to policy design and management implementation that can better support communities at different points in time and in different local contexts.

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1. Fire and Community

Scientists and professionals increasingly agree that the challenges associated with increasing wildfire incidence and impacts are grounded in and perpetuated by social forces. The legacy of U.S. wildfire suppression practices, facilitated by aggressive fire exclusion policies and public perceptions that fires should not be allowed to play a natural role in ecosystems near human development helped create unnatural fuel loading in forests and rangelands (Dombeck et al. 2004; Calkin et al. 2015). Increasing frequency and size of wildfires also is linked to anthropogenically induced climate change, increasing human ignition (Abatzoglou and Williams 2016; Balch et al. 2017), and the ever-expanding footprint of dense human development near or intermixed with wildlands, which is commonly referred to as the Wildland Urban Interface (WUI). The consequences of these trends are rapidly rising wildfire suppression costs at both the state and national levels and growing impacts or losses of private property in WUI communities (Gorte 2013; Mockrin et al. 2015; Paveglio et al. 2015a). Collectively, these factors have driven an urgent need to understand how populations living in the WUI can best adapt to the threat of wildfire.

Widespread interest in understanding social-ecological interactions in fire-prone landscapes raises difficult questions about how at-risk populations can "coexist" with wildfire and its associated impacts amidst ongoing ecological and climatic change (Moritz et al. 2014; Smith et al. 2016). Wildfire social science research to date has predominantly focused on identifying how wildfire risk can be proactively addressed in the WUI through an assortment of actions, management approaches, and policies that encourage greater resilience among WUI populations (McCaffrey et al. 2013; McCaffrey 2015; Toman et al.

2013). Less is known about how populations respond during wildfire events, and how they recover from subsequent impacts. Understanding the social-ecological interactions surrounding wildfire is further complicated by a mismatch in scales—while landscape-level efforts are often promoted by ecologists or other biophysical scientists, social resilience may need to be addressed at smaller scales (Prior and Eriksen 2013). Support for creating 'resilient landscapes' that reintroduce fire at more frequent intervals and in line with historic fire regimes has highlighted a need to understand how different populations will deal with increased fire occurrence, and the challenges they may face to reducing their risk at a range of scales.

Efforts to address wildfire at the local level often include discussions about the ways that private property owners should take responsibility for wildfire risk reduction to support community adaptation to fire. This means increasing the incidence of vegetation mitigation and retrofitting with fire resistant materials on private property, and adjusting expectations placed on fire professionals to protect structures and values at risk (McLennan and Eburn 2015; Brenkert-Smith et al. 2006; McFarlane et al. 2012). This transferal of responsibility is increasingly important for activities such as decision-making about evacuation, where residents are often required to make informed decisions about their safety in the absence of professionals. Efforts to understand responsibility are further complicated by the transferal of risk across boundaries, particularly between private and public lands where it may unclear who should take responsibility for fire impacts (Cyphers and Schultz 2019). The introduction of programs like Firewise and the Fire Adapted Communities Learning Network seek to support communities to take collective action and increase resident responsibility in landscapes where populations are increasingly required to 'live with fire'.

Looking forward, there is a need to encourage localized responsibility in ways that are sustainable and supported within the local culture.

The majority of efforts to understand how human populations adapt to or live with wildfire have been conducted at the local level. A segment these efforts argue that community is the most effective unit for understanding social dynamics in the WUI and for encouraging collective action (Paveglio et al. 2018; Flint et al. 2008; Jakes et al. 1998, 2010). Although 'community' is often thought of in geographical terms, a more useful approach may be those that explore community as an emergent and ongoing process that integrates people and place to explore the ways that human populations and ecological systems influence one another (Wilkinson 1991; Paveglio et al. 2016). Such efforts seek to understand the evolution of communities across time as the result of interactions between residents and professionals, fire events, and natural resources use. Several community-level programs for encouraging risk reduction have been introduced to support human community adaptation to wildfire, including the Firewise Communities USA program that facilitates wildfire mitigations that citizens can use on their private properties and the Ready, Set, Go! program that attempts to streamline evacuation processes for fire managers and residents. A focus on understanding the social aspects of wildfire at smaller scales has also emerged in policy. For example, the National Cohesive Wildland Fire Strategy highlights the importance of creating 'fire-adapted communities' as a critical goal for encouraging more resilient fire planning, which in turn can help promote fire-prone landscapes by lessening the burdens of wildfire suppression or exclusion (Steelman 2010; WFE Council 2014). However, there is less clarity about how the various programmatic or policy efforts designed to address wildfire risk may apply to the documented diversity of human communities

within the American WUI. It may also be important to consider the temporal utility of wildfire management strategies given the history, experience or anticipation of future fire events in any given location.

Efforts to understand community-level adaptation to fire illuminate details and frameworks for understanding the diversity of social context in the WUI. Numerous studies seek to highlight the differences between communities dealing with the threat of wildfire, and to understand how that diversity may influence the structure or form of wildfire management at a variety of scales (Meldrum et al. 2018; Paveglio et al. 2009, 2015b; Carroll et al. 2006). Findings from existing efforts suggested that there may be a plurality of applicable options for increasing local support for risk reduction, higher levels of involvement among residents in the WUI, and more effective approaches to prevent impacts from wildfire (Jakes et al. 2007; Charnley et al. 2015). Moreover, this research suggests that those various options for improving human community adaptation to wildfire may be more or less effective in certain places than others given the unique local functioning, history, and connections to the landscape in a given place (Paveglio et al 2009, 2012, 2015b; Jakes et al. 2007). All this is particularly important because human communities and their approaches to wildfire management continue to evolve, including locals' connections with one another, broader economies and local landscapes. Community adaptive capacity, or the ability of a community to act to address wildfire risk, is central to understanding social responses to wildfire. Paveglio et al. (2009, 2012) propose a list of 21 characteristics of local social systems organized within four broad categories: (1) interactions/relationships among residents; (2) access to and ability to adapt scientific or technical knowledge networks; (3) place-based knowledge and experience; and (4) demographic/structural characteristics.

These authors and subsequent research demonstrate how different combinations of these local social context characteristics can be used to explain differing community approaches to wildfire risk reduction. Understanding ways to increase community adaptive capacity is increasingly listed as a goal of scientists and policy makers seeking to reduce risk and impacts to people, property, and values in the WUI (Paton 2006; Paveglio et al. 2015a,b; Hamilton et al. 2018). Using our understandings of the varying local contexts that influence adaptive capacity across diverse populations offers an opportunity to tailor policies and management approaches to better align with community needs in response to changing fire risk.

2. Temporal dimensions of wildfire

Existing efforts to characterize social response to environmental hazards and their associated risks explore a range of temporal phases associated with a given hazard: (1) efforts to address potential risk *before* a hazard event; (2) behaviors, actions, and impacts *during* a hazard event; and (3) recovery from social and physical impacts *after* the hazard event. Each phase presents specific needs and opportunities for diverse actions at the individual or community level. Studies of hurricanes and earthquakes indicate that social responses to these events are temporally connected, and that outcomes from one hazard event can influence social responses to the next (Khalili et al. 2015; Cutter et al. 2008; Jakes et al. 2010). Despite an abundance of evidence to support the temporal connectivity of social adaptation to hazards, visual representations associated with temporal dimensions of hazards often are presented as linear (e.g. FEMA 2012), and it remains unclear if or how recovery efforts overlap with mitigation efforts for future risks. If community is defined as a process

that is continually changing and evolving over the duration of several hazard events, time might better be conceived of as a cycle that is altered by changes in risk.

Efforts to understand the temporal dimensions of wildfire are still relatively rudimentary, in part because of the absence of longitudinal studies or those that re-study locations at multiple times. Much of the existing wildfire social science research is focused on understanding pre-fire mitigation and prevention techniques, including household-level efforts to conduct mitigation activities on private property, understanding local wildfire risk perceptions, and exploring public involvement in wildfire issues (McCaffrey et al. 2013; Champ et al. 2013). Comparatively less is known about how populations experience fire events or the post-fire recovery process, including how these elements influence intended future response. Temporal dimensions of wildfire may be complicated by humans conception of the hazard and what caused it to be a hazard—while earthquakes are primarily conceived of as being driven by natural phenomena, wildfire also could be seen as including human influence introduced by forest policy, past management, development patterns and fire suppression responsibilities, that introduce the possibility for blame or complex discussions about linked management (Smith 2004). Where natural and 'unnatural' influences overlap, understandings of wildfire as a hazard become more complex and potentially harder to characterize temporally. Furthermore, the interconnectivity of wildfire with secondary hazards such as flooding or debris flows blur the lines of when impact or recovery wildfire event ends. This interconnectivity presents numerous opportunities for exchange of knowledge regarding community experiences between wildfire and other hazards.

Existing efforts to understand how communities interact with and adapt to wildfire risk over time identify how individual fire events, or human interactions surrounding fire and natural resources management more broadly, can have long-lasting impacts on local context. Paveglio and Edgeley (2017) suggest that community responses to fire can reinforce existing perceptions about the utility of wildfire adaptation strategies following consecutive wildfires, and that these responses are tied to an evaluation of past behaviors and interactions surrounding given fire events. Numerous research efforts describe wildfire events as creating social 'legacies' that inform interactions between people surrounding wildfire management, including reactive or proactive behaviors (McCool et al. 2006; Paveglio et al. 2015b). These legacies often create opportunities for change; there are often 'windows of opportunity' created by amplified public interest in fire management in the months following a wildfire that can drive shifts in social actions or policy change (Mockrin et al. 2018; Birkland 2006). Another frequently identified and temporally enduring consequence of wildfire is change in citizen-agency relationships, often centered on agreement or disagreement over wildfire management associated with the fire event (Olsen and Shindler 2007, 2010; Carroll et al. 2006). Distrust or trust between citizens and firefighting or fire management agencies can be a driving force of behavior at all phases associated with the "lifecycle" of wildfire. Acknowledging and incorporating existing social conditions in a WUI community may result in more streamlined efforts to introduce risk reduction or management approaches that also have positive consequences for citizen-agency interactions (Paveglio et al. 2018). Creating or adopting tailored to reduce risk that accommodate local contexts and needs offers a way to promote more sustained collective

actions that are able to minimize impacts from wildfire at all temporal phases of a fire event without compromising community identity.

Research that explores how different temporal phases of wildfire interact or overlap, and how these phases are defined and perpetuated by social interactions, can open new avenues to understanding the complexity of local contexts surrounding wildfire. Concerted efforts that look beyond a single point in time can provide more explicit understandings of how each phase influences another, and what social elements characterize these phases. The enduring nature of these interactions have implications for local support or adoption of future efforts to address fire, but how these efforts play out in pre-fire planning and subsequent fire events remains unclear. Additionally, understanding how communities develop social legacies based on experiences with specific fire events can be used to tailor communication efforts about mitigation, evacuation, and recovery in the future. Temporal dimension of wildfire at the community level also can provide insights for managers and other professionals to better anticipate potential social dynamics or foresee the social impacts of decision-making during future interactions.

3. Dissertation overview

There is a growing need to understand how communities experience wildfire and adapt (or maladapt) to it across a temporal gradient. It also is important to recognize and account for how this adaptation process varies within and between different populations. Social diversity and dynamics surrounding wildfire might change over time as communities undergo social transitions. Efforts to examine the temporal dimensions of community-wildfire interactions can produce better understanding of appropriate recovery resources and tools for impacted populations, tailor risk mitigation efforts to maximize their effectiveness,

and produce more in-depth knowledge about how resident interactions with fire change as a result of place-specific interactions with risk. While different temporal phases of wildfire have been previously studied at the community level, fewer efforts seek to look across different phases to understand how they are connected more explicitly.

Developing a broader temporal understanding of community-wildfire interactions opens opportunities for proactively designing relevant policy and management approaches that can anticipate the potential for social conflict or cohesion and proactively maneuver through these social conditions in order to support community adaptation to wildfire under different local contexts. In this dissertation I aim to examine each temporal 'phase' in the lifespan of wildfire management across different locations in order to gain a better understanding of how these phases interact and influence each other. Figure 1.1 maps out each chapter as part of a cycle, where past hazard events lay the social contexts that influence the next fire. The legacy of historic events, interactions, and experiences are an enduring product of fire events that remain prominent features in local contexts surrounding community adaptation. The research presented in this dissertation provides snapshots of different temporal phases in the life cycle of a wildfire, and seeks to understand how these temporal experiences and interactions may vary across different WUI communities. I seek to examine the temporal dimensions of community-wildfire interactions across these different

communities and their varying local contexts to better understand how socially diverse populations adapt to address growing wildfire threat.

Each chapter in this dissertation is intended to be a separate manuscript for publication in an academic journal, meaning that in some instances formatting, structure, and style may vary. The following sections briefly introduce each chapter and the phase in a wildfire event that it explores:

Chapter 2: "After a fire"

In this chapter I explore recovery experiences among rural communities affected by

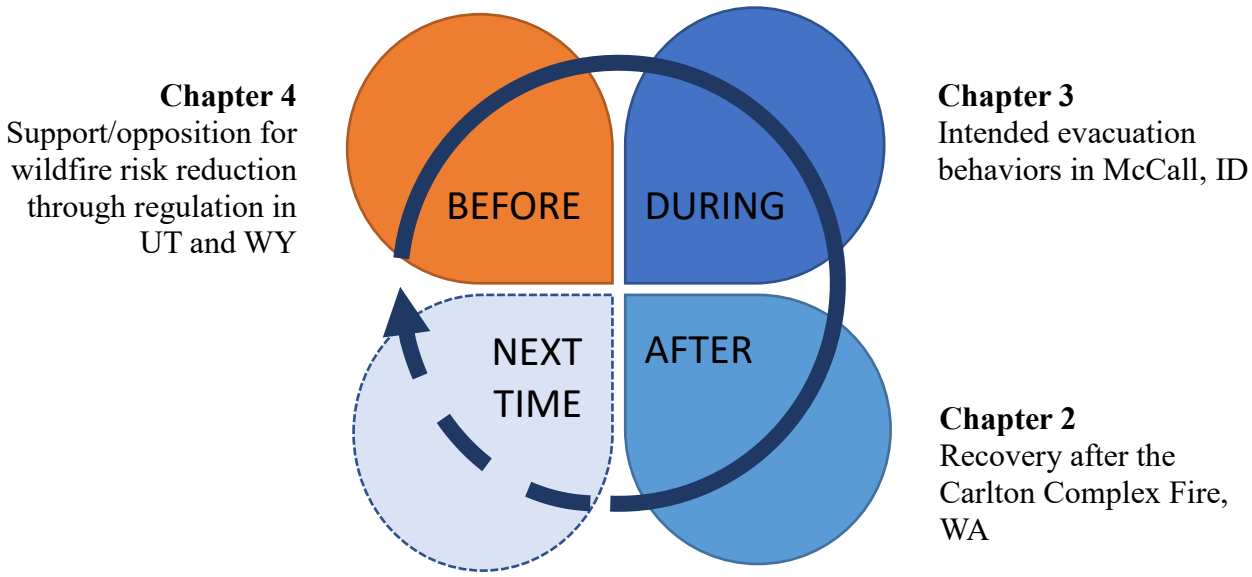

Figure 1.1: Outline of dissertation chapters and their alignment with different phases in the lifespan of a wildfire event.

fire. I review current approaches and assistance programs that are available for communities impacted by hazard events and outline existing research on the community recovery process. I share findings that emerged from interviews with 87 residents and professionals impacted by the Carlton Complex Fire in north-central Washington, conducted one year after the fire

event took place. Results suggest that current Federal assistance after disaster does not support the needs of rural communities trying to navigate the recovery process, which resulted in citizen-agency conflict and resident efforts to foster greater independence in the face of future fires. I make recommendations for improving assistance to fire-affected communities during long-term recovery and suggest how the social impacts of fire events may affect future wildfire management efforts.

Chapter 3: "During a fire"

In this chapter I outline household evacuation and its alternatives as identified in existing literature before reviewing current understandings of resident behaviors during wildfire events and how intent to undertake such behaviors may vary among different populations. I present data from 1,349 completed surveys of households in and around the city of McCall, Idaho, collected using a mixed-mode administration method. Three distinct groups of intended behavior emerged, each characterized by varying influences associated with both pre-fire mitigation and fire event interactions. A large proportion of respondents planned to 'wait and see' how the fire event unfolded before enacting their intended behavior. I provide suggestions for fire and emergency management professionals regarding tailored warnings among different populations and identify several areas where additional research is needed to understand the feasibility of different evacuation behaviors and their implications for resident safety.

Chapter 4: "Before a fire"

In this chapter I examine how local social context in two locations influences differential support or opposition for voluntary and involuntary mitigation efforts in more rural WUI communities. I describe different approaches to wildfire risk reduction currently

in place in different parts of the U.S. that aim to reduce wildfire risk and outline how community adaptive capacity can affect successful adoption or compliance with these efforts. This research is based on focus groups with 89 residents and professionals collected in two unincorporated WUI communities: Story, Wyoming (N = 45), and Timber Lakes, Utah (N = 44). I find that both communities are apprehensive about introducing policy or law that regulates resident behaviors due to differing interactions with government at various scales and feel that their an important part of their community identity and desire to live in the location are tied to a desire for local independence. However, residents in both communities were willing to consider various forms of involuntary action such as additional taxation if they could identify a direct benefit for themselves or their community. I discuss ways that decision-making about, and design of, involuntary measures that will affect WUI communities can be adapted to such local contexts, and conclude that sustainable fire adaptation is heavily influenced by identifiable benefit beyond simply reducing wildfire risk.

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Chapter 2: Community recovery and assistance following large wildfires: The case of the Carlton Complex Fire

Edgeley, C. M., & Paveglio, T. B. (2017). Community recovery and assistance following large wildfires: the case of the Carlton Complex Fire. *International Journal of Disaster Risk Reduction, 25*, 137-146.

1. Introduction

Hazard events such as hurricanes, earthquakes, and wildfires can produce diverse impacts that have the potential to disrupt ecological, economic, and social functioning in affected areas (Blaikie et al., 2014). Impacts from a given hazard event can be influenced by the social context in which they occur (e.g. local histories, resource management, and interactions among residents), and may require tailored approaches to recovery in the aftermath of disaster (Paton, 2013; Paveglio et al., 2015a).

Hazard event characteristics, including intensity, magnitude, and duration, all may differ depending on the social context of a given area (e.g. local histories and interactions among residents) and can generate impacts that require tailored approaches to recovery in the aftermath of disaster. Every hazard event may consequently have a different recovery trajectory, necessitating a unique supply of appropriate aid that can effectively address local needs. The research presented here explores social influences on the recovery trajectory of human populations impacted by a large-scale wildfire event.

Extra-local assistance often is essential after disasters and other impactful hazard events because local resources may be overwhelmed or unable to fulfill the long-term needs of affected populations during recovery (Quarantelli, 1986; Tierney and Oliver-Smith, 2012). Recovery aid can be provided by community members, local organizations, and

extra-local bodies such as state and federal agencies (i.e. Federal Emergency Management Agency [FEMA]) or non-governmental organizations ([NGOs] such as the Red Cross) (Smith, 2011). Recovery support for hazards can come in many forms, including immediate basic needs like food and water, individual household rebuilding and repair, provision of mental health services, and community-level assistance to restore infrastructure (Phillips, 2009).

Federal disaster assistance to communities impacted by wildfire remains modest in comparison to other hazards, despite the increasing number of wildfires recorded annually in the United States (FEMA, 2017). As a result, a comparatively small amount of existing research explores the availability, distribution, and demand for aid following wildfire. Local perspectives surrounding post-fire aid are an important component of the recovery process (Paveglio et al., 2015a). Numerous studies indicate that extra-local approaches to disaster recovery have the potential to influence conflict or collaboration among community members. Such conflict or collaboration also can result in more or less successful recovery trajectories by dictating the efficiency of collective action, including the organization, allocation and use of recovery resources (Carroll et al., 2006; Kumagai et al., 2004a). Social dynamics following impactful hazards, and the recovery process, also can have profound effects on collective or individual efforts to mitigate future risk (McCaffrey, 2015). Differing levels of support for extra-local assistance have been observed in response to federal assistance for several disasters in recent years, most notably towards FEMA assistance after Hurricane Katrina (e.g. Schneider, 2008; Nelson et al., 2007; Nicholls and Picou, 2012).

Despite a wealth of research on the type and allocation of recovery aid following hazards, there is less research that explores impacted populations' beliefs about the adequacy of aid provisions and the factors that influence their perceptions at a local level. That deficiency is especially true of wildfire hazards, which are expected to grow in both number and size in nations across the world. The research presented here responds to these gaps by studying community recovery from a wildfire event in Washington state, USA. The Carlton Complex Fire burned 104 square miles in north central Washington during the summer of 2014. It damaged or destroyed 353 homes across a rural area (State of Washington, 2014a). Results presented in this paper reflect findings from 64 interviews with 87 individuals who were involved in post-fire recovery following the Carlton Complex Fire or who were impacted by the event. Our aim was to explore how social interactions surrounding the wildfire influenced recovery dynamics.

The role of social influences on disaster recovery efforts is increasingly important in the face of larger, more impactful fires near human settlements (Dennison et al., 2014: Mell et al., 2009; Toman et al., 2013.) A more comprehensive understanding of the social factors influencing long-term disaster recovery trajectories has the potential to advance both science and practice surrounding hazards. For one, advancing knowledge about recovery dynamics is particularly valuable following large fires that can simultaneously affect diverse human populations. Fires may create different recovery needs (e.g. assistance with rebuilding structures, slope stabilization, infrastructure repair) due to factors such as availability of resources and different prioritizations of recovery activities in the immediate event aftermath. Systematically documenting differences in recovery needs could help identify flexible strategies for providing recovery aid across diverse populations. Likewise,

exploration of influences on conflict or cohesion surrounding recovery processes has the potential to maximize the efficiency of future recovery efforts. Exploration of the social influences on hazard recovery also may encourage additional preparation for future hazard events through the recommendation of mitigations that best reflect local values-at-risk or that reduce what are perceived as the most significant potential impacts from a given hazard.

2. Literature Review

2.1 Addressing hazard impacts through disaster assistance

A large body of literature explores how hazards can affect economic, ecological, and social functioning (NRC, 2006; Smith, 2004). Impacts from wildfires can include property damage, human injury or death, damage to infrastructure (e.g. powerlines, fencing, etc.), consumption of timber or wildland vegetation, and impacts to ecosystem functioning (e.g. wildlife habitat, water quality, post-fire erosion) (Paveglio et al., 2015a, Phillips, 2009). Existing research increasingly demonstrates the importance of understanding social impacts as a benefit to or detraction from effective hazard recovery. Lindell (2013) broadly classifies social impacts from disasters as economic, political, demographic or psychological. Paveglio et al. (2015b) place social impacts from wildfire into three broad categories: (1) loss of life, property, and economy (Mockrin et al., 2015), (2) disruptions to social processing and functioning (Carroll et al., 2006, Paveglio et al., 2015a), and (3) local perceptions of and reactions to fire impacts (Collins and Bolin, 2009).

Extra-local assistance often plays a vital role in supporting impacted communities during disaster recovery (King, 2007; Carroll et al., 2006). Governments, agencies, or organizations at multiple scales (e.g. local, state, and federal) can supply assistance at a range of timeframes. Federal disaster assistance in the United States often is provided at the

national level through the Federal Emergency Management Agency (FEMA). FEMA was established in 1979 with the intent of providing supplementary financial support to US communities recovering from disaster. The Robert T. Stafford Disaster and Relief and Emergency Assistance Act of 1988 aids FEMA in providing federal disaster assistance contingent on: (1) a formal request for assistance from a state governor, followed by (2) a Preliminary Damage Assessment (PDA) and subsequent Major Disaster Declaration authorized by the President (Platt, 1999). PDAs are usually conducted using one of three surveying approaches: (1) "windshield surveys" in vehicles guided by local representatives; (2) door-to-door surveying of affected residents; or (3) aerial fly-by assessments. PDAs are intended to assess the impact of a disaster and the extent of ensuing damages in order to determine the resources required for successful recovery (FEMA, 2012). PDA findings form the basis for state governor requests regarding presidential disaster declarations. Once a disaster has been declared, the Stafford Act also enables the President to determine which forms of assistance will be supplied, and the conditions under which this aid will be provided (Bea, 2005). State-level assistance may also be available to communities in disaster following the declaration of a state of emergency. This could include tax breaks for impacted residences and businesses from the state government, funding of debris removal, or provision of resources such as reseeding or slope stabilization materials by state agencies (Perry and Lindell, 2007).

Large wildfires often exceed local capacity for fire management and subsequent recovery needs, leading to a greater dependence on extra-local support from organizations like FEMA during the recovery process. The scope of the U.S. federal disaster assistance has expanded over time to address a wide range of recovery needs. FEMA now invites

applications for two central types of assistance: (1) Public Assistance (PA), which provides aid that state and local governments can use to repair or replacement infrastructure; and (2) Individual Assistance (IA), which incorporates numerous programs designed to aid recovery at the household level. IA can include the Individual and Household Program, which aims to resolve immediate needs of residents or property owners dealing with property damage and provide permanent housing accommodation solutions for those who have lost homes. It also can include the Small Business Administration program, which offers loans to support the reestablishment of local businesses. Finally, IA can include the Disaster Unemployment Assistance program, which provides financial assistance for individuals who become unemployed as a result of disaster. Allocation of IA is variable based on documented recovery need and impacts are assessed on a case-by-case basis, while PA can be provided regardless of the economic stability of an area (Platt, 1999; Bea, 2005). Areas profoundly impacted by a disaster event can often receive both IA and PA for tangible losses. Floods and severe storm events have received the vast majority of federal disaster assistance since FEMA was established (FEMA, 2017). There are fewer incidences of federal aid provisions to wildfires, and some of that is understandable given that disastrous wildfires are reported far less frequently in comparison to other hazards such as floods and hurricanes.

The FEMA approach for allocating disaster aid across the United States receives ongoing criticism in the face of increasing demand (McCarthy, 2011). Early reports described FEMA as possessing a "lack of consistency in the quality and methods of assessment… [that] creates doubt as to whether the federal government is only providing supplementary assistance and whether each request is judged in a fair and equitable manner" (USGAO, 1981: 22). A 1994 audit of FEMA concluded that there was no standardized

method for assessing state and local government capability to determine disaster assistance needs (Platt, 1999). Schneider (2008) identified a mismatch between how affected citizens and FEMA understood the assistance process, suggesting that the intended recovery process was challenging to enact during a real disaster and that FEMA responsibilities during the application process were unclear. More recently, a number of authors have critiqued federal disaster assistance processes for having a distinct absence of objective criteria. Some of these recent criticisms came in response to high-profile hazard impacts such as Hurricane Katrina (Hooks and Miller, 2006). Likewise, Sugarman (2007) argued that thresholds for disaster declarations and how they are measured remain blurred—there are no clear guidelines regarding thresholds for assessment including the spatial extent the disaster should span, or the level of damage required in order for an area to qualify for federal assistance. FEMA is currently considering potential amendments that may give more weight to thresholds based on objective federal data, but this alone will not be used to determine aid provisions due to the unique nature of every disaster (DHS, 2015).

The application process for federal assistance, and what some authors describe as its limited capacity to adapt to unique and dynamic situations (Carroll et al., 2005), can lead grassroots organizations or extra-local NGOs to assume leadership roles for assistance after a hazard event (Gajewski et al., 2011). Another reason these organizations assume leadership roles during recovery can be limited local resources to address post-disaster issues (e.g. documentation of damage, communication with agencies or governments). Extra-local organizations typically provide basic necessities for impacted populations. For instance, larger NGOs such as the American Red Cross and Salvation Army can offer mass care, including temporary shelter or food and water, across large disaster areas (Smith,

2011). Numerous NGOs now coordinate under the collective heading of Volunteer Organizations Active in Disaster (VOADs). VOADs enables participating NGOs to coordinate aid provisions and share new information as it becomes available to maximize response efficiency (NVOAD, 2008). NGOs and local organizations can help ease the transition from short-term to long-term recovery, while FEMA may supply long-term financial assistance to meet specific individual and public needs.

2.2 The post-disaster recovery process

Understanding the needs of affected populations following an impactful hazard event or disaster is essential for an effective recovery (Bolin and Stanford, 1998; Kapucu et al., 2013; Lindell and Prater, 2003; Paveglio et al., 2015a). Traditional observations of the disaster recovery process identify four key stages: (1) the disaster impact and immediate aftermath; (2) a honeymoon phase during which community cohesion is often high and altruistic actions are common; (3) a *disillusionment* phase characterized by increasing challenges associated with the transition into long-term recovery efforts (e.g. emotional and psychological recovery, reestablishing permanent housing); and (4) *reconstruction* or *recovery*, which focus on restoring local functioning and infrastructure during the course of several years (Townsend et al., 2015). FEMA adopted an alternative continuum that spans three key phases: short-term, intermediate, and long-term recovery. Each phase prioritizes actions addressing recovery needs that emerge across time following the hazard event (FEMA, 2011). The duration of each phase is uncertain, and likely varies between communities based on the type and severity of the disaster(s) experienced.

Wildfire events often catalyze distinct recovery efforts that span the recovery phases described above. Initial needs may include cleanup of debris, repair and rebuilding of

structures, reestablishment of infrastructure, and assistance to mitigate secondary hazards such as flooding (Phillips, 2009; Smith et al., 2016). Some intermediate post-fire needs are considered more controversial because they engage diverse perspectives about landscape or natural resource management. For example, decisions regarding salvage logging on burnt lands often bring economic needs and environmental recovery into sharp contrast (Mendez et al., 2003; Ryan and Hamin, 2008). Crop or timber reestablishment can be central to the recovery process in resource dependent populations (Flint and Luloff, 2005), which can create agriculture-specific needs such as repairs to fencing, reseeding, and slope stabilization. Longer-term recovery can focus on implementing mitigation efforts that reduce the risk of subsequent fires (e.g. establishment of fuel breaks, evacuation planning), or attempt to change residents' attitudes towards wildfire and its associated risks in ways that facilitate longer-term planning (McGee et al., 2009; Brenkert-Smith et al., 2006). Regardless of the framework used, the values of local populations can often influence perceptions of the recovery process or priorities for that recovery. For instance, Paveglio et al. (2015c) found that some rural residents impacted by the Columbia Complex Fire were more concerned with timber loss than structure protection, and adjusted their recovery efforts accordingly.

The emergence of cohesion or conflict surrounding wildfire origin, suppression efforts, or recovery is another commonly cited impact of hazards on local social functioning (Carroll et al., 2006). Acknowledging the legacy of these conflicts also can play an essential role in understanding community needs and recovery during subsequent hazard events, including support for future mitigation efforts (McCool et al., 2006; Carroll et al., 2006; Jakes and Langer, 2012; McGee, 2011). Altruistic actions and collective efforts to address immediate needs in the aftermath of fire events can foster cohesive communities. Such

cohesion is commonly observed where the cause of a hazard is perceived as unavoidable or a chance event (Slovic et al. 1987; Kumagai et al., 2004a) and often is short-lived. However, it acts as a coping mechanism during the transitory period from the immediate aftermath to long-term recovery (Barton, 1969; Olsen and Shindler, 2007), and can lessen psychological distress among affected populations (Afifi et al., 2012). Community members often note how local cohesion following hazards fosters shared experience and increases future collaborative potential among individuals or groups. It can also open up opportunities to develop common understandings or planning approaches across interest groups (Kulig et al., 2013; McCaffrey, 2015).

Pre-existing social context can influence the emergence of conflict following wildfires (Carroll et al., 2005, 2006; McCool et al., 2006; Cohn et al., 2008; Paveglio et al., 2015b). Relationships between residents and professionals, people and the landscape, demographic changes, and established social norms can all collectively determine social context (Paveglio et al, 2016). For example, citizen-agency conflicts can emerge from disagreement about fire management or suppression approaches, decisions about prioritizing and allocating resources for protection, and inclusion of local knowledge and resources in fire suppression efforts (McCool et al., 2006; Olsen and Shindler, 2007, 2010). Impacted populations might blame extra-local organizations for fire impacts, particularly when these impacts are perceived as being caused or exacerbated by extra-local actions. Likewise, the tendency to blame other social groups for impacts associated with wildfire can stem from or create longer-term distrust in governmental agencies managing public lands or among groups (e.g. timber professionals and environmental groups) with different opinions about ecosystem management (Kumagai et al. 2004b; Olsen and Shindler, 2007; Carroll et al.,

2005). Paveglio et al. (2015c) note that local resident expectations for firefighting agencies can sometimes be unrealistic, a consideration which is particularly salient when public pressure for rapid agency decision making is particularly high (Olsen and Shindler, 2010; McCool et al., 2006). Public interests often lie at specific local scales, while agencies that manage for wildfire and its threat often work at a broader regional or landscape-level scale (Olsen and Shindler, 2007). Failure to acknowledge the difference in geographical focus among populations brought together during a hazard event can lead to ongoing citizen-agency conflict. The temporal longevity of conflict after a wildfire event is unclear, although there is increasing evidence that it may be enduring. This may be particularly true in rural communities where residents often have more experience with fire (Kumagai et al., 2004b; Carroll et al., 2006, 2011; Paveglio et al., 2015b).

Bureaucratic procedures surrounding recovery also can foster conflict among impacted communities and extra-local organizations (e.g. state or federal agencies) that designate post-disaster relief assistance. Impacted communities and individuals may consider some rules and procedures that determine access to recovery assistance as impractical, including the requirement of written damage assessments to receive FEMA aid (Schneider, 1992). For instance, Hooks and Miller (2006) found that the indecisive nature of FEMA's IA assessment process and a lack of consideration about how impacted individuals would access application resources were among the reasons for displeasure with government assistance after Hurricane Katrina. Conflict surrounding post disaster assistance can create cascading social effects such as inequalities in recovery among those who can fund their own rebuilding projects and those who must rely on government aid processes for the chance to access federal funds (Fazio, 2014; Muñoz and Tate, 2016).

In summary, existing literature highlights a growing need to understand the recovery process after wildfire, perceptions of disaster aid provision, and social interactions after disaster events. Limited research examines citizen expectations of recovery assistance following wildfires, and influences that may shape these expectations. Likewise, little research explores whether bureaucratic processes can create or exacerbate conflict after wildfire events. Many existing wildfire recovery studies focus on the immediate aftermath of an event or 'short-term' recovery activities. Studies that examine longer-term recovery progress beyond the first two or three months after a large wildfire are increasingly important as fire sizes are projected to increase, placing communities at risk of more severe and enduring impacts (Dennison et al., 2014). Olsen and Shindler (2010) note that large fires are often a one-off career experience for fire management professionals. Thus, research to understand the social dimensions of large wildfire events and their recovery are an important need because there are fewer professionals who have personal experience with such events. The research presented here addresses these research gaps using a case study of long-term recovery from a large fire. We ask the following research questions in response to the above literature review:

1. How do instances of cohesion or conflict surrounding a wildfire influence the recovery process?
2. How do populations affected by wildfire view the recovery aid process?

3. Methodology

3.1 Site selection and fire event

Researchers compiled a database of wildfire events that impacted human populations in the U.S. states of Washington, Oregon, Idaho or Western Montana during 2013 and 2014.

This timeframe was chosen so that researchers could enquire about short-term and potentially longer-term recovery activities, but not so long that participants could not recall important information or detail about the wildfire event. Information about wildfires was obtained from public agency or organizational reports and media coverage. This included information about any fire event declared as a disaster through the FEMA process or that included recovery aid from federal or state levels. We used Paveglio et al.'s (2015b) criteria for social impact assessment to assess initial fire impacts. Their criteria include disruption to local functioning, property loss, conflict surrounding fire management, subsequent policy changes, and others. We selected the Carlton Complex Fire in north-central Washington state for this study because there were a variety of impacts stemming from the event**,** and because enough time had passed to obtain perspectives about short-term and longer-term recovery. Researchers conducted open-ended phone interviews with key informants using an initial protocol to confirm that wildfire impacts were widespread and post-fire recovery in the area was ongoing. Key informants included fire management professionals, local city government representatives, and land management agencies who had experience working with affected communities before, during, and after the fire.

The Carlton Complex Fire began as four separate lightning-ignited fires on July 14th, 2014. The four fires merged on July 17th and continued to burn until August 25th. Numerous organizations and agencies were involved in efforts to suppress the fire, including the Washington Department of Natural Resources (DNR), the US Forest Service, and local volunteer fire departments. The Carlton Complex Fire burned 256,000 acres of public and private lands in Okanogan County, resulting in a diverse array of impacts to several rural communities and surrounding areas (see Paveglio and Edgeley, 2017 for an in-depth

description of three affected communities). The fire resulted in damage to 353 houses, 256 of which were completely destroyed (State of Washington, 2014a). Damage to powerlines, water storage tanks and other essential infrastructure were reported as a result of the fire, while losses of livestock and crops (including orchards) also were reported. No fatalities were directly related to the fire event, though locals indirectly attribute two deaths to the fire (i.e. a heart attack and injuries sustained during suppression efforts). There is a history of large and impactful fires in Okanogan County, including the Thirtymile Fire of 2001 and the 2006 Tripod Complex. Approximately 57% of Okanogan County consists of federal and state public lands, with the remaining area characterized by small rural communities and low population density (State of Washington, 2014a).

Federal representatives conducted a three-day Preliminary Disaster Assessment of Okanogan County, which led to a Major Disaster Declaration on August 11th, 2014 (FEMA, 2014). Local officials requested financial assistance from FEMA, and received Public Assistance (PA) totaling $2.35 million to reestablish local infrastructure (FEMA, 2014). However, FEMA denied Individual Assistance (IA) for impacted residents and property owners. State government officials appealed the FEMA decision to withhold IA for the Carlton Complex Fire using updated information on impacts and losses to private property collected by the local government without success (State of Washington, 2014b).

3.2 Data collection

The authors conducted 65 interviews with 87 participants across Okanogan County during the course of two weeks in the summer of 2015. Interviews took place approximately one year after the Carlton Complex Fire began. Interview participants were identified using a mixture of theoretical and snowball sampling. Theoretical sampling is used to identify

participants who have specific knowledge or expertise surrounding phenomena of interest (Charmaz, 2000; Bryman, 2012), in this case professionals and local figures who were knowledgeable about fire management, local impact and recovery from the Carlton Complex Fire. The authors conducted interviews with: (1) professionals who had been involved in management and/or recovery from the fire, including firefighters, emergency management officials, law enforcement, local government officials, and public agency representatives; and (2) residents from across the impacted area. 53 interviewees suffered some form of property damage during the Carlton Complex Fire, with 22 of those interviewees reporting that the fire destroyed one or more of their structures. The authors conducted resident interviews in person at interviewees' Okanogan County property whenever possible. They conducted interviews with professionals in areas of importance to fire progression or impacts. Conducting interviews in the burned area enabled improved understanding and discussion regarding wildfire impacts. It also provided an opportunity to observe ongoing recovery across affected communities.

Researchers asked each respondent to recommend additional study participants who could provide insight to the research questions outlined above. This approach to gathering participants is known as snowball sampling, and can be used to collect new and in-depth information that is not immediately apparent (Biernacki and Waldorf, 1991; Lindlof and Taylor, 2010). Researchers also conducted spontaneous interviews with residents who were approached in public areas and via home visits without previous contact. These impromptu data collection opportunities ensured that researchers' understandings of the event were well rounded, and ensured that data collected from key informants was representative of the broader local population.

The authors used a semi-structured interview protocol that allowed follow-up questions and expansion of initial points identified by respondents. Initial questions from the protocol focused on: (1) respondent experiences with the Carlton Complex Fire; (2) perspectives about fire management or suppression; (3) wildfire impacts to the respondent or the broader population; and (4) recovery efforts. Interviews ranged from 22 minutes to two hours. Both authors conducted the majority of interviews together. They discussed emergent themes and findings at the end of each day in the field. Initial discussions among authors allowed for potential revision of the interview protocol and preliminary development of emergent themes for later analysis (Saldaña, 2016). All but two interviews were recorded. Two participants requested not to be recorded and the authors took handwritten notes in both those instances. Both authors also attended a long-term recovery organization (LTRO) meeting intended to advance recovery progress from the wildfire. Observing the LTRO meeting provided researchers the opportunity to understand organizational perspectives about post-fire recovery efforts and gather information about impacts. Interviews continued until both authors agreed that theoretical saturation had been reached, meaning that no new information was being obtained from interviews and that initial themes were consistent across respondents (Thornberg and Charmaz, 2014).

3.3 Data analysis

All interview recordings were transcribed word-for-word for additional analysis. The authors built on initial emergent themes developed in the field using processes of analytic induction and thematic analysis. Analytic induction is used to develop causal explanations about events and occurrences using multiple iterations of increasingly restrictive coding (Ryan and Bernard, 2000). Thematic analysis can complement the analytic induction process

by identifying common patterns or differences among respondents' reported experiences surrounding a given event (Gibbs, 2007). Using both approaches simultaneously enabled the identification and characterization of final themes.

Researchers coded transcripts for each interview using qualitative analysis software QSR NVivo. They were guided by the processes of analytic induction and thematic analysis described above. To begin, both researchers separately coded the same random subset of interview transcripts for descriptive codes. Researchers then compared these transcripts to confirm that codes were identified and used consistently to achieve intercoder agreement (Saldaña, 2016). Both researchers then collaboratively developed an initial codebook detailing properties for each theme, which identified the relationships between descriptive codes and deeper meaning commonly attributed across interviews (what some refer to as analytic coding). They then pursued an iterative multi-step coding process whereby new topics and information uncovered in each transcript was either subsumed under an appropriate existing theme, or a new theme was created. This process is sometimes referred to as progressive falsification (Strauss and Corbin, 1990). The first author took primary responsibility for coding, but regularly consulted with the second author to triangulate ongoing theme development. Finally, representative quotations for each theme were extracted to exemplify key findings (Boyatzis, 1998).

4. Results

4.1. Conflict over fire suppression aggressiveness

Residents indicated that proactive, aggressive agency firefighting had led to the successful management of local wildfires in the past, and that they had come to expect this aggressive fire suppression approach to fire ignitions in the area. One resident explained

how fires had typically been fought in the area prior to the Carlton Complex: “you would always have DNR coming immediately or smoke jumpers would be deployed, and they would always, I mean, they took care of fire the way it was supposed to be taken care of.”

Some respondents were unhappy with the DNR approach to fire management during the Carlton Complex Fire. They did not feel the agency fought the four original fire starts aggressively enough and suggested that the scale and resultant impacts of the Carlton Complex Fire were preventable if a more aggressive suppression strategy had been implemented. These residents portrayed DNR firefighters as risk adverse and passive during the fire event. As one resident described:

> There was a [DNR] brush truck and just a pick-up, a command vehicle the guy called himself, parked out here on the fairway out behind our house. They stayed all night. When I asked them why aren't you fighting fire, well it's too dangerous. As we're throwing dirt at it with shovels, and they’re sitting in the freaking pick-up with the air conditioning on.

Locals’ disappointment surrounding fire suppression also stemmed from pre-fire expectations that the DNR would prioritize private property when determining how to allocate their firefighting resources. They contrasted the DNR’s ‘hands-off’ suppression approach with descriptions of local fire department crews as risk-takers who were devoted to protecting life and property at any cost. This relentless attitude about fire suppression met the expectations that locals had about “proper” firefighting tactics. Reports or anecdotes (often shared via informal stories among locals) that the DNR declined to accept help or resources from the local fire department and local residents fueled an impression among some that the DNR had done a poor job managing the fire. Respondents also suggested that

suppression efforts were hindered by some DNR employees' unfamiliarity with the area or the use of young, undertrained firefighters.

> I said (to the firefighters) on the other side, you can't let it get across Cow Creek there, because it's gone. Well, the first night, they let it cross Cow Creek there. And I watched the trucks and the crews drive along the road watching that fire, holding back not trying to stop it. One truck after another there, and I'm going well, what's the plan, what's going on? It was like they had no plan.

A group of residents have filed a lawsuit against the DNR claiming that the Carlton Complex Fire was a preventable disaster. These residents cited the DNR's passive firefighting approach as a contributing cause for losses and the large amount of land that was impacted by the wildfire. One resident summed up their frustration as such: "had there been somebody there in charge who told the DNR to take a flying leap and stopped it [the fire], it could have been stopped. That's why they're being sued."

It is important to note that not all residents were critical of the DNR fire response. This led to a divided opinion about the appropriateness of the pending lawsuit, and one source of internal conflict among residents impacted by the event. As another respondent explained:

> You get these really conservative people up here that don't want any government intervention. They don't want all this s**t. They want the government to stay away, which is great. Fine. The first time the government doesn't do something good, the first thing they want to do is sue them. That's kind of like me saying "I've got a

restraining order against my ex-wife and I'm gonna sue her because she didn't mow the lawn." I mean, it doesn't make sense. You can't have one without the other.

4.2 Uncertainty and unhappiness over FEMA aid assessment

Respondents disagreed with or were upset about the FEMA decision to withhold IA for those impacted by the Carlton Complex Fire. They felt that IA could help residents deal with immediate and longer-term issues raised by wildfire impacts, including unmet needs that were not well accounted for in FEMA assessments. Unmet needs that could advance recovery at the property level included rebuilding fences, houses, moving debris, and replacing damaged belongings. As one respondent articulated: "To build the fence – cattle fence is $8,000 a mile, deer fence is $16,000 a mile on average – and the fire burned everything, non-insurable item. So the orchardists, the cattlemen, everyone had to rebuild their fence on their own."

Another factor influencing local arguments for IA was the belief that the fire could have been prevented with more aggressive firefighting. Because some respondents felt that DNR and other agency management of the fire had allowed the Carlton Complex Fire to grow out of control, they also felt that there was a government responsibility to help with recovery. Respondents reported that area residents saw this as financial reciprocation from the government. As one resident explained: "I mean if they're [the DNR] going to freaking make a rule that you can't put it out, then my God you'd better pay [for it]." Several residents used IA denial to rationalize the ongoing lawsuit against the DNR, using the legal platform as an alternative opportunity to receive financial assistance for recovery.

Respondents in our study, including local government officials, felt that FEMA reasoning for IA refusal was unclear. They indicated that the collective needs of residents

and communities spread across the broad area impacted by the fire were deserving of federal aid. Two main factors characterized residents' perspectives about denial of IA during the Carlton Complex Fire: (1) FEMA officials had a poor understanding of the rural west, including threats or impacts to local values and the severity of impacts from the fire, and (2) the application process for federal assistance was unclear and led to misunderstandings about the representation of disaster needs. We review these two themes in the following sections.

4.2.1 FEMA's understandings of the rural West

Residents and professionals indicated that FEMA did not possess the capacity to understand or accommodate disaster needs in rural western communities. This concern stemmed from a larger belief that FEMA did not fully understand western livelihoods and landscapes, including what recovery needs were required following the fire (e.g. clearing rubble and debris from damaged property, proximity to alternative housing during rebuilding) or the impact that any losses would have in a rural area. As one resident summarized: "In a rural area like this… there isn't density, population density to meet that monetary threshold to where it (i.e. assistance) kicks in. Anybody in a rural area is, 'forget FEMA, it is a joke.'" Both local officials and residents indicated that FEMA did not consider wildfire as a hazard that caused the type of impacts for which they provide assistance. Others felt that the FEMA application process did not accommodate hazards such as wildfire:

> They [FEMA] don't understand fire in the way they deal with stuff, it's not part of the process. Now we've been able to work around some of that, and I think that's why the Individual Assistance failed – because fire is not part, if it had been flooding

> and the same amount of houses lost, but a flood, I think it would have passed. I think it would have gone right through, because they [FEMA] understand floods.

Officials and residents involved in the Carlton Complex Fire asserted that urban areas were more likely to receive IA than rural ones. Part of this was due to the above perception that agency officials did not understand rural communities, and because those respondents felt FEMA criteria favored larger population centers through a focus on the total amount of impacts rather than the relative impact to people. Some respondents noted that national FEMA offices are based in cities, and suggested that this could contribute to inadequate understandings of disaster needs and capacity to request aid in rural communities. As one resident described: "The government is based on the east coast. Their [FEMA's] mindset, we're the wild west." This spatial disparity also was noted at the Washington state-level, with one fire professional stating: "three-hundred houses on the west side of the state is very different from three-hundred houses on this side of the state."

Comparisons between the Carlton Complex Fire and the Oso mudslide were a common feature in arguments that IA should have been granted following the wildfire. The Oso mudslide occurred in western Washington four months before the Carlton Complex Fire, and FEMA provided both IA and PA to those impacted by that event. The mudslide destroyed 49 homes and resulted in the deaths of 43 people. Carlton residents and officials felt that both Oso and the Carlton Complex deserved IA based upon the impacts that were unique to each area, population and hazard. They indicated that Oso had a lower overall number of destroyed properties across a significantly smaller area, while the Carlton Complex Fire destroyed many more properties across a diverse swath, affecting a number of small communities and economies. A failure to see the difference in the discrete or diverse

impacts of the two hazards led to a focus on one factor that respondents felt could not be denied—the loss of life in Oso. As one resident summarized:

> Oso, you know, got Individual Assistance for the individuals of the Oso mudslide. Oso lost lives, and every one of those lives is a tragedy. But FEMA is not supposed to be life insurance. FEMA is supposed to be assistance to the population on an individual basis in response to disasters. FEMA said no to us while the fire was still burning. We were still amassing losses when they turned us down.

Another comparison between the two disasters focused on the proximity of Oso to a major city. Respondents thought that the Oso disaster garnered long-lasting media and social attention because it was approximately 50 miles away from Seattle and near a major highway corridor. In contrast, the area affected by the Carlton Complex is located in a sparsely populated region of north-central Washington. Oso also was closer to the nearest FEMA office in Bothell, which is a suburb of Seattle. The result of this proximity and added attention, at least according to Carlton residents, was a contributing factor behind Oso residents receiving IA while Carlton Complex residents were denied.

4.2.2 Experience with the FEMA application process

Recovery processes surrounding the Carlton Complex Fire raised questions among locals about the fairness and clarity of the FEMA assistance application process. Respondents identified a lack of transparency in the application requirements and the assessment process for federal disaster assistance. Officials explained that FEMA provided them with generalized descriptions about the thresholds needed to qualify for disaster assistance (e.g. extent of property damage), but those descriptions did not have much specificity, which left them uncertain about whether they would qualify. As one local

official stated: “If you read the rules and what can trigger Individual Assistance, we easily qualified.” The perceived lack of clarity surrounding assessment criteria led to uncertainty about which aspect of the application ultimately disqualified the Carlton Complex from receiving IA. As one respondent described:

> We got the information, but basically from what I was told from learning and sitting through this, it’s their choice. They go back and the rules change. Every disaster is different. They make up the rules when they get back there [FEMA headquarters] … the rules do change.

Both residents and professionals criticized FEMA officials’ reliance on the three day ‘window tour’ (referred to by FEMA as a ‘windshield tour’) as an effective method of PDA data collection. The concern was that the window tour did not provide an accurate representation of the extent or range of impacts sustained during the Carlton Complex Fire. According to respondents, FEMA missed opportunities to communicate with local officials in compiling the most comprehensive and inclusive data when reporting damages. One resident explained:

> Things could have been done better for assistance and analysis. Number one, talk to the locals first – which they [FEMA] didn’t. They talked to intercommunication (sic) government officials and they went on a car tour basically, a window tour. The fire’s 400 square miles. It’s four times the size of the City of Seattle, and they took a window tour on the major roads. What do you think they really saw?

Respondents indicated that the short and intermediate recovery phases after the fire were chaotic—there was an incomplete understanding about the extent of damages or losses

across the broad area impacted. Though groups were organizing local assistance efforts, there was limited time, human resources, or expertise to adequately and simultaneously collect all the information needed for the more formal disaster assistance process through FEMA.

One important challenge following the wildfire was a shortage of local knowledge about federal disaster assistance and the associated application process. Few individuals in the area had experience applying for federal hazard assistance because hazards of a similar scale and impact to the Carlton Complex Fire were relatively rare in the area. Local officials described being unsure about how to navigate the federal aid application process in order to accurately represent impacts across several diverse rural communities. They also indicated that there was no consistency or continuity among visiting FEMA representatives, both in terms of the individuals who visited and the advice and information they provided. This local deficit in access to resources or experience about communicating disaster needs necessitated outside expertise in the immediate aftermath of the fire. Respondents described how local government employees utilized the help of Team Rubicon to help guide officials through the application process. Team Rubicon is a VOAD formed by military veterans. The organization provides structured post-disaster assistance, including help coordinating resources, documenting resources, and navigating the accounting requirements needed to assess impacts or volunteerism following hazard events. Local government officials described Team Rubicon's extra-local assistance as vital in counteracting limited local capacity to meet FEMA requirements:

> You know [small rural] cities can't, there's not enough resources for a FEMA expert to be on the staff. The state needs a FEMA expert to come out and say this is what

you've got to keep track of, you shouldn't have to rely on Team Rubicon. It was a godsend that they [Team Rubicon] were there.

4.3 Recovery and lessons learned

Our analysis and respondent comments indicate a heightened interest in improving local autonomy following the Carlton Complex Fire. Conflicts over the way the DNR fought the fire, and associated IA denial influenced sentiments among some that extra-local agencies could no longer be trusted to respond appropriately during future wildfires or other disasters. That is, locals felt that future fire suppression would not be as aggressive as necessary to minimize losses, and that FEMA could not be depended upon to provide assistance. As one government official explained:

> *My job's the safety and the welfare of the citizens of this county, and if I don't think they [extra-local agencies] can do it…then to hell be damned with them, because we're going to do what we have to to protect our citizens. We're not going to let this happen again.*

Experiences with the DNR and FEMA surrounding the Carlton Complex Fire also were described as influencing the ways that residents intended to interact with extra-local agencies during future fires. Locals made efforts to clarify residents' right to stay and defend their properties during wildfire or help put out fires on neighboring state land. It also meant building local volunteer capacity to aggressively fight fire, delineating how local governments would make decisions about hazard management independent from other authorities, and establishing a reverse 911 system that could provide rural residents with more timely information during future events. As one resident described: "Now, if it [a fire]

involves us, there'll be hell to pay, they're [DNR] not going to run us off. I mean I'll call the cops."

Residents felt that their communities had been effective in organizing local assistance and recovery efforts in order to overcome deficiencies in extra-local assistance. For instance, multiple communities established drop-off/distribution points for donations and coordinated meals for those who were displaced. Impacted respondents also indicated how important these local resources and community altruism were to their personal recovery from the fire. Neighboring communities and local governments assisted with specific short-term and intermediate recovery needs across impacted rural areas such as shelter for livestock. Several residents orchestrated the formation of a long-term recovery organization (LTRO) to address unmet needs in the absence of federal assistance. The LTRO served as an overarching framework for three distinct recovery efforts that each addressed the impacts unique to a geographic region affected by the fire. Respondents felt that this ability and success in drawing on local resources during recovery phases highlighted the potential to act independently after disasters. As such, and because of growing distrust about extra-local assistance (i.e. DNR suppression and FEMA assistance), locals impacted by the fire intended to focus their efforts on building autonomous capacity to respond during hazard future events. As one resident explained: "When a disaster happens in a local community, you better figure it out yourself quick, and you better not wait for somebody else to do it for you."

5. Discussion and Conclusions

The research presented here aimed to address two core needs in wildfire disaster recovery research: (1) advancing understanding about how conflict or cohesion surrounding

wildfires can influence human recovery from the hazard; and (2) describing how populations impacted by wildfires conceive of or interpret recovery aid process. In the following sections, we discuss how our findings from the Carlton Complex Fire contribute to wildfire social science and the long-term recovery literature. We also discuss how our findings lend themselves to suggestions about changes to post-wildfire recovery policies or procedures.

5.1 Social influences on hazard recovery

Our results suggest that views about the aggressiveness of DNR firefighting influenced how local residents and professionals collectively approached recovery. First, some locals' belief that mismanagement of suppression efforts led to the resulting extent of losses during the Carlton Complex Fire defined efforts to improve local capacity for future response (e.g. reverse 911, local suppression capacity, etc.). Disagreement about the way the fire was fought also deepened residents' distrust of firefighting agencies and resulted in efforts to "blame" or recoup losses from other organizations, which could take energy away from other recovery efforts. In that respect, conflict surrounding fire response has reverberated through the recovery process, and will serve as the basis for potential future interactions surrounding fire impacts (Carroll et al. 2011; Paveglio et al. 2016).

Existing disaster literature can help us understand how disagreement about suppression response can influence relationships surrounding broader wildfire management, impacts or response. A number of authors delineate potentially divergent social responses to hazards, suggesting that "technological disasters" tend to be associated with conflict and blaming behaviors, whereas "natural disasters" are often characterized as inevitable and therefore serve to unify communities during recovery (Carroll et al., 2005; Phillips, 2009). A third category of "hybrid" (or "na-tech") hazards can combine elements of technological and

natural disasters (Smith, 2004). Hybrid hazards have the potential to create both conflict and cohesion surrounding disaster events because their origins can be linked to both natural processes (e.g. river flows, seismic activity) and historical or ongoing social actions (e.g. levee construction, mining contamination). Hybrid hazards can create greater potential for dispute due to the potential to "blame" social actors for a natural event (Kumagai et al. 2004a; Carroll et al., 2011). In our case, some residents determined 'technological' or human influences (e.g. DNR firefighting) to be a cause of the widespread impacts from the Carlton Complex Fire. Thus, our findings serve to illustrate how wildfires can be a "hybrid hazard" that locally affected populations can associate with both natural conditions and human actions (Smith, 2004; Carroll et al. 2011).

Disagreement about firefighting tactics or the tendency to "blame" firefighters for the extent of a fire has been shown to create public distrust in agencies following such events (McCool et al., 2006; Paveglio et al., 2015b). Likewise, unresolved conflict following a wildfire event can increase social fragmentation (Carroll et al., 2005), which contradicts ongoing policy efforts (e.g. Fire Adapted Communities Program) that encourage resilience to hazard events through cohesion. This appears to be the case in the aftermath of the Carlton Complex Fire, with locals indicating that they felt early efforts to address the fire could have prevented the scale of the hazard. What makes this case somewhat unique is that some of this local disagreement with state agency response (DNR) also appears to have transferred to expectations of recovery offered by a federal agency (FEMA). Though locals felt recovery aid was necessary due to the extent of impacts (see below), they also felt that someone (or some organization) had to take accountability for impacts that could have been

avoided. FEMA assistance could serve as an acknowledgement of that fact, and in that way, served as a means for recovery to residents.

Legal efforts against the DNR, which could be seen as another means to assign responsibility for the fire, also have the potential to perpetuate conflict between local residents and extra-local groups. Existing hazard literature indicates how previous interactions surrounding fires can serve as the underlying "structure" that guides future resident and agency interactions (Olsen and Shindler, 2010; Paveglio et al., 2015b). In our case, some residents have lost faith in government aid services tied to hazards (e.g. fire suppression and recovery response). This has the potential to stimulate local adaptation or responsibility, but it can also lead to an unwillingness to take personal or collective responsibility for risk (e.g. future mitigations or planning) (Stidham et al., 2006; McCaffrey et al., 2013; Paveglio et al., 2012).

5.1.1 Hazard comparisons and recovery aid

Research surrounding other disasters emphasizes how hazard events are not temporally isolated from each other and can collectively influence community disaster experiences (Tierney and Oliver-Smith, 2012). Wildfire literature indicates how individuals or groups often make comparisons between hazard events as a tool to understand hazard risk, extent, and severity (e.g. Newman et al., 2014). Likewise, individuals can use previous hazard events from their locality as a frame of reference and to gauge the impact of a given fire event (Martin et al., 2009). While these comparisons are often implied, few studies have directly observed them or made efforts to determine how they might influence the trajectory of recovery efforts among populations.

Residents in our case used comparisons between the Oso mudslide and the Carlton Complex Fire to justify their perceptions of unequal federal aid. That is, residents compared their social circumstances and losses to a nearby hazard in order to make judgements about what recovery they should receive from the federal government. Salient features of those comparisons, including the proximity of Oso to a populated area and its prominence in the media, created what Carlton residents felt were more favorable circumstances for receiving individual assistance aid. In summary, our findings suggest that residents' tendency to draw comparisons across hazards when trying to understand a given event might extend across both hazard types and geographical regions. In fact, residents affected by hazards may use neighboring comparisons to highlight what they perceive of as social injustices in the way that hazard recovery is allocated.

Our findings are another indication that the impacts of a given wildfire can have long-lasting legacies in terms or recovery or future actions (Carroll et al., 2011; Paveglio et al., 2015b). They indicate a need for future investigation into the "social lifespan" of wildfires or other hazards on local perceptions of risk or recovery. This could include the collection of longitudinal data regarding locals' and professionals' views of the recovery process, how full recovery might be achieved, what criteria would be used to evaluate that recovery, and influences on differential length of recovery phases across hazards.

5.2 FEMA assistance in rural communities

Disaster events have the potential to bring together diverse social groups and organizations who interact infrequently (Barton, 1969; Olsen and Shindler, 2007; Townshend et al., 2015). For instance, significant impacts from any hazard event may mean the entrance of disaster aid agencies (e.g. FEMA, Red Cross, VOADs) that operate using a

set of standardized rules and procedures to maximize their effectiveness across cases (Smith, 2011). One enduring challenge of hazard response is the potential mismatch of policy or practices underlying those institutions and the culture or perceptions of hazard-affected populations. This includes variation in the needs and values of populations affected by such events, and the variable ways that they come to understand how the actions of those organizations are structured. Our research demonstrates that the social context defining populations impacted by a given wildfire hazard can help explain the challenges of administering hazard aid. It also helps us understand what factors can drive residents' perceptions of that process. We provide examples of these lessons in the following paragraphs.

FEMA's decision to deny IA for impacted households following the Carlton Complex Fire raised concerns among locals about the fairness of assistance allocation. Many residents felt that their experience with IA denial was indicative of broader FEMA issues, including a poor understanding of potential hazard impact to rural lifestyles or communities. Respondents supported their claims by highlighting what they felt were incomplete or inaccurate accountings of losses across the disperse properties and values impacted by the fire. They also described a difficulty interpreting the flexible criteria and process for documenting losses to receive or justify aid. These concerns align with existing critiques of FEMA assistance, including: (1) a lack of transparency about the process surrounding assistance allocation (Hooks and Miller, 2006); (2) difficulty obtaining data for or completing the documentation necessary to receive aid immediately following a disaster event (Hooks and Miller, 2006); (3) uncertainty about the assessment criteria for aid

allocation (Sugarman, 2007); and (4) perceived inconsistencies in the ways the organization prioritizes requests for aid (USGAO, 1981).

Addressing concerns surrounding FEMA application of aid is a difficult process for a number of reasons. To begin, large and impactful wildfires like the Carlton Complex Fire can be an infrequent event in rural communities. This may mean there is little precedent or previous experience preparing local residents and professionals to address the needs hazard events may create during each recovery phase (Olsen and Shindler, 2010; Prior and Eriksen, 2013). Rural community officials and residents also may have limited knowledge or training for disaster recovery at a large scale. Therefore, residents may come to rely too heavily on FEMA during navigation of the recovery aid process or suggest that their practices were insufficient. The aforementioned factors likely had a significant influence on a perceived lack of transparency or uncertainty about criteria for aid in this case study. It also highlights the need for mobile, nimble technical assistance during hazard events, including organizations that can serve as a bridge between locals and FEMA when it comes to understanding and interpreting the recovery process.

Results from this study suggest that organizations like VOADs have the potential to serve as organizations that might help alleviate growing challenges associated with wildfire impacts and recovery. This assistance might come in the form of individuals who help negotiate, organize and document aid efforts after a disaster. Documentation of aid efforts can be a critical part of the disaster aid application process, especially when it comes to outlining needs for federal assistance (Hooks and Miller, 2006). In sum, VOAD intervention can fill gaps in resources and skills following disaster. Coordination and quick deployment of VOAD organizations may be extremely valuable in rural, under-resourced communities

by presenting opportunities for smoother transitions between short, intermediate and long-term recovery, and quicker initiation of recovery-focused activities from the outset. A critical factor will be whether communities trust and are willing to work with those VOADs. As such, we would advocate for additional research on the structure and patterns of VOAD use across wildfire hazards. Detailed analysis of such efforts may help provide best practices that streamline early aid for rural communities, and help VOAD organizations maximize their network of volunteers.

Addressing residents' concerns about the applicability of aid criteria to rural populations and potential inequities in aid pose a different, but related set of problems. To begin, the increasing impacts from wildfire to rural western communities suggests a growing need for increased transparency and improved access to comprehensive information about the federal recovery aid process. Our respondents' frustration with the FEMA application process also indicates a need to make FEMA assessment criteria and related recovery aid information more readily accessible to both the public and local governments. However, such sweeping generalizations alone oversimplify the complex reasons those problems exist. For instance, FEMA criteria are broad in order to make dynamic and flexible decisions about the need for aid, and concrete or purely quantitative criteria are likely to bias decisions regardless of the criteria chosen. The infrequent probability of wildfires that necessitate a need for FEMA aid also might give local emergency managers or officials less incentive to seek out or stay current with such information.

The above discussion suggests that any strategy for increasing transparency and familiarity with FEMA criteria among rural populations needs to be multi-faceted, and might include the following: (1) prioritization of communities most likely to experience

significant losses during fire events using existing or emergent risk simulation research; (2) development and dissemination of more approachable summaries for the FEMA decision processes (e.g. criteria, logic) among prioritized communities; and (3) coordination with and use of VOAD groups among communities experiencing uncharacteristic wildfire impacts. Finally, it appears that the consistency of personal contact with FEMA representatives made a difference in this case. This suggests a potential need for research exploring the use and efficacy of dedicated state or federal aid officials who take primary and longitudinal responsibility for working with affected residents during the course of recovery. That includes the duration that officials might operate in a hazard-affected area in order to facilitate challenges associated with long-term recovery.

While it is beyond the scope of this paper to comment on whether FEMA should have provided IA for those impacted by the Carlton Complex Fire, our results do suggest a need to consider whether FEMA criteria for disaster aid may need additional qualification in order to better reflect the potential impacts of wildfire in rural regions. The argument made by locals and the Washington State government was that FEMA officials did not understand or consider the *relative* impact of the disaster to the Carlton area given its existing context. The importance of that criticism lies in a recognition of variable vulnerability or impact from a given hazard event based on existing social and biophysical context. As such, any decision to provide aid would likely need to take a contingent approach. That approach might benefit from consideration of the intensity with which the wildfire affected pre-hazard functioning (e.g. economically, socially, in terms of ecosystem services) rather than by any particular threshold.

Section 320 of the Stafford Act currently states that "no geographic area shall be precluded from receiving assistance… by virtue of an arithmetic formula or sliding scale based on income or population" (FEMA 2016: 21). However, our results suggest that residents and state-level officials were unclear how that broad mandate did or did not apply to the Carlton case. It suggests a critical need for research regarding the individual criteria or justification for past or ongoing FEMA decisions about allocation of aid. This could include document analysis and tracking of aid received during past events. Another useful area of inquiry might include embedding researchers or third-party neutral officials in the decision-making progress to document the logic or reasoning behind such decisions. Results from those efforts could help to make the process of aid allocation more approachable to a variety of populations, and help in the dissemination of criteria as discussed above.

6. Conclusion

The growing risk wildfire poses to human populations across North America (and elsewhere) ensures that assessment of hazard impact and subsequent recovery assistance will be important in the future. While a significant consideration in that aid will be an equitable process for assessing impacts incurred, it can also create long-term legacies for the people who live in the area affected, agencies influencing or suppressing wildfire hazards, and government institutions supplying aid. There is currently a deficit of understanding regarding how populations affected by wildfire approach recovery, and the influences that shape that process. Existing federal approaches to recovery focus largely on tangible criteria for responding to physical impacts. However, residents' and professionals' experiences surrounding the Carlton Complex Fire indicate that social dynamics between locals and extra-local organizations is a crucial component in fostering conditions for successful

recovery. The influence of these interactions on the "social lifespan" of a hazard, and how this legacy comes to define social interactions during subsequent events, is a critical piece of any conversation about changing wildfire risk.

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Chapter 3: Exploring Influences on Intended Evacuation Behaviors During Wildfire: What Roles for Pre-Fire Actions and Event-Based Cues?

1. Introduction

Increasing wildfire occurrence, size, and intensity pose a growing threat to human safety in areas where people live in proximity to or interspersed with wildland vegetation. Fire management professionals across multiple countries predominantly advocate evacuation as the safest action residents can take when threatened by a wildfire. However, existing research notes that while some residents may opt to evacuate to a safer place, others may choose alternatives to evacuation, including staying and actively defending their property from fire, or passively sheltering in place inside a structure or open area (McLennan et al. 2014; Paveglio et al. 2010, 2014; McCaffrey et al. 2015). Residents living in fire-prone landscapes often indicate that they have given thought to their intended actions during wildfire and demonstrate preferences for some actions over others depending on the context of the particular fire event and its associated risk (Meldrum et al. 2018; Strahan et al. 2018; McNeill et al. 2016).

The lack of understanding surrounding which action(s) residents intend to take when threatened by fire, and the influences that drive or change these decisions at different points in time offers one opportunity to better manage risks to citizen and firefighter safety. Improvements to citizen safety can come from better understanding the ways that people make adaptive evacuation choices and providing information or warning cues that will allow them to make informed decisions. Likewise, improving systematic understanding of resident evacuation choices can help reduce instances where firefighters take additional risk to protect human life or property, and when evacuation would remove the need to pursue such

aggressive tactics. The study presented here identifies potential evacuation dynamics and their possible influences on wildfire management in a rural city in central Idaho.

Existing research indicates there are two predominant categories of influences on residents' intended evacuation behaviors: (1) pre-fire preparation or mitigation activities (e.g. development of an evacuation plan, fuels reduction around a property); and (2) how individuals interact with the characteristics of a given fire event or associated safety warnings (McCool et al. 2006; McLennan et al. 2012). Included within these broad categories are a variety of attitudinal and perceptual characteristics, including experience with past fires, attitudes towards fire management, and risk perceptions (Paveglio et al. 2015a; Mozumder et al. 2008). For instance, actions undertaken before a fire event have been found to significantly influence residents' evacuation decision-making processes, including the extent to which a homeowner believes their property is prepared to withstand flames or embers, or whether they have made evacuation plans such as pre-determining an evacuation location (McCaffrey and Winter 2011; Whittaker et al. 2013). Less is known about how emergent, context-specific factors such as sudden changes in fire behavior or evacuation warnings might influence or alter evacuation decision-making at the household level during a wildfire (McLennan et al. 2013; Eriksen et al. 2016; Thompson et al. 2018). Building a better understanding of these emergent or contextual influences on decision-making can help explain the challenges surrounding evacuation coordination or why residents do not always heed evacuation warnings or recommendations.

One theme spanning studies of wildfire evacuation is the prevalence of 'wait-and see' behaviors (e.g. McLennan et al. 2012; McNeill et al. 2016). 'Wait and see' behaviors occur when at-risk populations delay action on evacuation or its alternatives until negative

outcomes seem more probable. Others may wait for cues that trigger action, such as an in-person evacuation notice from authorities, before turning their ultimate decision into action (Tibbits and Whittaker 2007; McCaffrey et al. 2018). Fire professionals widely advise against delaying evacuation decision-making during fire, as it may lead to a higher likelihood of evacuee exposure to flame fronts or additional risk caused by low visibility due to smoke. 'Wait and see' approaches also can force residents into involuntary sheltering practices as a last resort and often without proper preparation (Whittaker et al. 2013; McCaffrey et al. 2018).

Continued public interest in adopting 'wait-and-see' approaches and a lack of understanding about how residents in fire-prone landscapes determine intended behavior during wildfire warrants further research, particularly regarding how different temporal cues may influence decision-making about various evacuation options. The research presented here addresses these needs by exploring the influence of pre-fire preparation efforts and event-based cues on intended behavior during wildfire among residents in central Idaho, USA. We analyze data from 1,349 completed household surveys in the McCall, Idaho, area concerning stated evacuation behavior, private property wildfire mitigations, evacuation cues, and perspectives about wildfire management. Results from our analysis can be used to identify strategic locations for evacuation centers or road closures and to develop tailored messaging about evacuation and safe actions during wildfire. This data also can support the development of decision support tools to assist residents and professionals in making informed decisions about evacuation or its alternatives and when to safely implement these actions.

2. Literature review

Decision-making about evacuation or its alternatives during wildfire events generally involves two overarching considerations: (1) deciding which action(s) members of a household should take; and (2), determining when to undertake that action (McNeill et al. 2015). Existing research indicates that citizen responses to imminent wildfire risk (e.g. evacuation or alternatives to evacuation) can be diverse and wide-ranging across the Western United States, in part because residents who are 18 years of age and older have the legal right to remain on their private property for the duration of a hazard event (Mozumder et al. 2008; McCaffrey and Rhodes 2009). The following sections review different evacuation behaviors or alternatives to evacuation, including how intent to undertake such behaviors may vary among different populations and the influences on different options.

2.1. Pre-fire influences on evacuation and its alternatives

Evacuation to a safe location is the most commonly advocated response to an impending wildfire among law enforcement and emergency management in multiple fire-prone countries. Professionals typically encourage evacuation when fire threatens private property and advise that the decision to leave is made as early as possible (Cohn et al. 2006; Mutch et al. 2011). A long history of research also explores alternatives to evacuation, including the choice to passively shelter in place inside a structure, or to stay and defend, typically by actively suppressing fires to reduce damage to values-at-risk or threat to life safety (Cova et al. 2009; Paveglio et al. 2010). Stay and defend activities can be organized at the household level or as part of a collaborative effort, either through formalized approaches coordinated with firefighting officials or informally using verbal agreements among neighbors (see Stasiewicz and Paveglio 2017; Paveglio and Edgeley 2017). Residents may

intentionally choose alternatives to evacuation when they become aware of an imminent fire threat, or employ them when fire conditions change suddenly and the decision to evacuate cannot be enacted safely (Johnson et al. 2012). Less research explores the reasons why residents choose alternatives to evacuation or disregard official advice about evacuation during fire, though protection of private property investment, safety of livestock, and distrust or lack of faith in agency firefighting efforts have been explored in some studies (Cote and McGee 2014; Paveglio et al. 2015b).

Research has increasingly demonstrated that the diverse local contexts of residents living in fire-prone landscapes may influence their preferences for evacuation or alternatives to evacuation, including previous experience with fire, residential development patterns, risk perceptions, community norms or practices, and relationships with emergency management professionals (Paveglio et al. 2009, 2015). For example, many who opt to stay and defend have firsthand experience fighting fire, or a history of employment in natural resource-related fields (McLennan et al. 2013; Cohn et al. 2006). Variations in resident responses during wildfire can be partially formed by pre-fire social conditions, including what other area residents intend to do during fires and whether residents have performed mitigation efforts such as vegetation reduction, establishment of water sources, and construction of buildings in ways that would increase the chances that property could survive a wildfire without damage.

Gender is consistently identified as an indicator of evacuation decision-making. Women tend to have higher risk perceptions both before and during fire. They are also more likely to favor evacuation or SIP than men (Tyler and Fairbrother 2013). Gendered responses to wildfire risk may lead to divergent evacuation behaviors within households,

with men more likely to stay and defend the property while women and children evacuate (Proudley 2008). The age of household inhabitants also can influence decision-making during fire events. McNeill et al. (2016) reported in an Australian case study that households intending to leave early were more likely to have children than other evacuation groups. Older residents are less likely to have conducted extensive fuel reduction on their property and thus may be less likely to stay and defend their properties (Paveglio et al. 2016).

Residents' risk perceptions can influence decisions to invest time, money and effort in wildfire risk mitigation on their private property. Risk perceptions, in-turn, can be one influence on decision-making about evacuation and the survivability of property in their absence (Cohn et al. 2006). For instance, those who have high wildfire risk perceptions also tend to plan more comprehensively for evacuation or its alternatives, yet this effect is somewhat variable across populations (McLennan et al. 2015). Few studies have sought to explore the degree to which wildfire mitigation efforts are correlated with intended evacuation behaviors. Researchers have found that those planning to stay and defend their home during wildfire were more likely to have conducted mitigation activities on their properties (e.g. Cote and McGee 2014; McLennan et al. 2015; Paveglio et al. 2010). However, a primary message associated with wildfire mitigations concerns its utility to those intending to evacuate, namely the survivability of private property without residents or firefighters present. This paper addresses the above incongruence by exploring the relationship between mitigation (or lack of mitigation) and intended evacuation behavior. Our research efforts can help identify pre-fire correlates of behavior during fire, which in turn may help explain why different households within the same population take different actions.

Commonly advocated preparations for wildfire events may include the discussion of evacuation plans with neighbors and other household members, placing important documents and information in a safe and accessible location, preparing an emergency kit, and planning multiple evacuation routes (Eriksen et al. 2016; Prior and Eriksen 2013; McNeill et al. 2015). Completion of such household-level hazard planning can increase resident safety during wildfire events (Tibbits and Whittaker 2007; Whittaker et al. 2013), yet there are fewer studies that have explored the proportion of at-risk residents who have completed these actions. McCaffrey et al. (2018) suggested that residents who plan to stay and defend possess greater knowledge about wildfire preparedness. They indicate that residents' belief that their household was well prepared was more influential in their decision to evacuate or stay and defend when compared to the number of mitigation activities undertaken on that property. Experience with previous fires can positively affect preparedness; however, those who have survived a prior disaster may also be less likely to show interest in evacuating during future events (McCaffrey & Kumagai 2007; McGee et al. 2009). Dunlop et al. (2012) indicated that residents who were more likely to delay evacuation decision making were typically less prepared for wildfire in comparison to stay and defend or evacuee groups.

Changing situational factors during the onset of a wildfire, including local context characteristics and official evacuation notices are instrumental in residents' decisions to evacuate (McCaffrey et al. 2018). Yet there is comparatively little research linking these event-based cues with broader influences on decisions to evacuate or employ alternatives to evacuation. Therefore, our next section reviews existing research on the ways that different

situational cues trigger response and explores influences on decision-making during wildfire events.

2.2. The influence of event-based cues on evacuation behavior

The role of dynamic, event-based cues in influencing decisions to evacuate is complex given the range of potential impacts and emergent outcomes during fire events. Event-based cues may determine or alter the perceived feasibility of different intended behaviors during fire, requiring residents to take planned action or improvise an alternative plan to stay safe. The most common event-based influence discussed in existing literature is the receipt (or absence of) an evacuation warning message, either in person from officials or other citizens, or through secondary sources such as social media, TV or radio (Whittaker et al. 2013; Sutton et al. 2008). Fire behavior, including the proximity of the fire to private property and the speed at which it travels, can influence both evacuation behavior and the timing of evacuation and its alternatives. Likewise, previous research indicates that the behaviors of neighbors or family and friends also can serve as cues about when to implement decisions about evacuation at the household level (Cohn et al. 2006; Kuligowski 2013).

Numerous studies suggest that resident compliance with evacuation notices is highly dependent on the information conveyed and how much trust the recipient has in the source (McCaffrey et al. 2013; Steelman and McCaffrey 2013, Steelman et al. 2015). Evacuation notices received from fire professionals or emergency managers can be more effective among some populations, while others may already have made a decision to remain and are unlikely to be influenced by persuasive arguments (Paveglio et al. 2008). Shared plans to

evacuate or stay and defend may also influence how evacuation cues are interpreted, as the decision becomes a collective and not just an individual consideration (Cohn et al. 2006).

Receipt of an evacuation warning or awareness of a fire that threatens a resident's property does not necessarily result in immediate evacuation (Roberson et al. 2012; Whittaker et al. 2013). Residents considering 'wait and see' behaviors are prevalent in many recent studies of wildfire evacuation behavior (Strahan et al. 2018; McNeill et al. 2015). Tibbits and Whittaker (2007) suggest that those who opt to stay and defend during a wildfire may view late evacuation as a last resort if the fire is too dangerous, and that such planning might indirectly be considered a 'wait and see' option. The unintended consequences of 'wait and see' behaviors can be severe. Several research efforts have attributed civilian fatalities during wildfire to late evacuation during unsafe conditions or when the threat from fire is imminent, causing residents to become trapped at their property (e.g. Haynes et al. 2010; Krusel and Petris 1992). Understanding why residents opt to 'wait and see' or do not plan for wildfire requires attention because these populations may incur more risk and impacts as a result of their inaction (Tibbits and Whittaker 2007; Whittaker et al. 2017).

Decisions about whether to 'wait and see' often differ among households according to event- or site-specific context. They can be associated with warning fatigue from past wildfires that had no local impact, concern about the effort and time it may take to evacuate (e.g. moving livestock when it was not absolutely necessary), and the potential impacts of evacuation on daily life or routine (e.g. not being able to attend work). The perceived safety of and ability to protect values-at-risk, including livestock, pets, structures, timber or agricultural crops, has frequently been cited as an important influence on decisions about when or whether to evacuate (McNeill et al. 2016; Cote and McGee 2014). Meanwhile, less

effort has been made to understand how residents consider fire behavior, including proximity of the fire or the rate of fire spread, when planning decisions about enacting evacuation or stay and defend actions (Cova et al. 2017, McLennan et al. 2013).

Analysis of self-reported data at the household level offers one avenue for identifying the factors that influence evacuation decision-making during fire. The literature outlined in the previous sections highlights a number of pre-existing and emergent event-based factors that influence decisions to evacuate or employ alternatives to evacuation. It also indicates how those factors can have variable influence across members of the same geographical population. The research presented here investigates intended behaviors during wildfire events and their correlation with pre-fire mitigation activities or event-based cues among household members surrounding McCall, ID. It builds off of Paveglio et al.'s (2014) study in Flathead County, MT, by exploring how emergent preference categories of intended evacuation behaviors (e.g. evacuation, stay and defend, shelter in place) relate to event-based cues or mitigation actions on private properties. We ask the following research questions in response to the above needs:

1. What types of evacuation behaviors do residents in the McCall area intend to implement during a wildfire?
2. How does performance of mitigation actions or fire planning differ across any emergent groups of intended evacuation behaviors?
3. What preparation or event-based factors correlate with intended evacuation behaviors among McCall-area residents?

3. Methods

3.1 Study area and sample frame

McCall is the largest city in Valley County, Idaho. The area is popular for its recreational opportunities, including two ski resorts and a state park. The McCall city center is situated along Payette Lake and the area is adjacent to mixed conifer stands that make up the Payette National Forest. Access to amenity resources is correlated with a large seasonal population, and approximately 51% of the properties within McCall city limits are secondary residences (U.S. Census 2017). Several wildfires have threatened properties and infrastructure in the broader McCall area during the last three decades, most notably the East Zone of the Cascade Complex Fire in 2007 and the 1994 Blackwell Complex and Corral fires. There is a significant fire management presence in the McCall area, including the McCall Fire Department, rural fire departments, and a U.S. Forest Service smokejumper base situated at the city airport. The Valley County Sheriff's Office implements a three-level evacuation warning system during emergencies such as wildfire. Local politicians, emergency management officials, land management agency representatives, and residents successfully designated the city of McCall as a recognized Firewise Community in 2015 (Paveglio and Kelly 2018).

The sample frame for this research consisted of three distinct 'zones' identified using GIS parcel data obtained from local counties and the city of McCall. Those zones are: (1) an area within the McCall City boundaries (excluding downtown, which was identified by both density of commercial properties and absence of vegetation detected using satellite imagery); (2) a buffer extending 1.5 miles from the city boundary; and (3) a buffer extending an additional 1.5 miles from Zone 2. The 1.5-mile buffer distance used for zones

2 and 3 is a commonly cited distance used for designating Wildland Urban Interface properties, and is linked to firebrand travel distances (Paveglio et al. 2013). The sample frame resulting from the above GIS process allowed for the potential inclusion of participants across broad social and ecological gradients in both Valley County and neighboring Adams County. We used attributes of the GIS parcel data to focus our sample on only residential parcels in the study area. More specifically, we removed any properties within the zones described above that were characterized as family or state trust lands, businesses or other commercial properties, and apartments and condominiums. The above process resulted in 2,767 primary and secondary residences that were eligible to receive the survey.

3.2 Survey design and administration

We developed a survey instrument for data collection during the spring of 2016. Two sources influenced survey design and development: (1) a survey conducted by Paveglio et al. (2014) in Flathead County, MT, that sought to better understand the relationship between resident attitudes, evacuation behaviors, and property mitigation; and (2) information gathered from four 2015 focus groups with a cross section of McCall residents and professionals that discussed community-level wildfire risk perceptions and risk mitigation activities in the area (see Paveglio and Kelly 2018 for findings). We shared a draft version of the survey with five experienced survey researchers, who provided suggestions for improvement. Researchers piloted the instrument in June 2016 among 29 households near Moscow, Idaho, to pre-test and refine measures (Willis 2017).

The final survey included three categories of questions which form the basis of the analysis presented here: (1) property-level mitigations for wildfire; (2) intended behaviors

during wildfire; and (3) household planning for evacuation activities. Additional questions elicited demographic information and asked questions about trust in and responsibility for fire management. Table 3.1 provides an overview of variables used in our analysis (all tables can be found at the end of this chapter). These topics were selected based on the existing literature described in the previous section.

We assessed resident performance of property-level wildfire mitigation efforts in the Home Ignition Zone (HIZ) using a series of 11 yes/no questions that are commonly used to assess structure ignition risk (Firewise 2012; NFPA 2007; Paveglio et al. 2014). The HIZ is the area surrounding a home which primarily influences fire risk and structure damages during a wildfire (Cohen 2008). Respondents were asked to report whether they had completed a series of vegetation management actions across three distinct areas within the HIZ: Zone 1 (within 30ft of the structure); Zone 2 (30-100ft); and Zone 3 (100-200ft). Questions inquired about the presence of thinning, removal of branches, and creation of a 30-foot green space, among other actions. Respondents also were asked to indicate whether any HIZ mitigation efforts were in place when they purchased their McCall-area property, and whether they had maintained or added to these efforts during the past 10 years.

Intended behaviors during fire were explored using 12 Likert scale questions that asked participants to indicate their agreement or disagreement with a series of statements about evacuation behavior. These prompts were adapted from a past study of intended actions during fire (i.e. Paveglio et al. 2014), and have been successfully used to indicate of intended behavior during a wildfire.

Another section of the survey used Likert-scale ratings to gauge how influential or uninfluential a range of event-based and preparation-based cues would be on respondent's

decisions to evacuate. Event-based cues included influential factors identified in existing literature, including changes in fire behavior, evacuation notices, and perceived safety of household members (Strahan et al. 2018; McCaffrey et al. 2018; Eriksen et al. 2016). Preparation-based cues reflect pre-fire influences uncovered in previous research, including questions about perceived property safety, and respondent confidence in their ability to defend the property. A related question asked participants to indicate whether they had completed planning tasks related to evacuation, including establishing potential evacuation routes and intended destinations.

A final set of questions investigated respondents' preferences for wildfire management strategies. These Likert-scale questions asked respondents to indicate their level of trust in local, state, and federal firefighting agencies and to indicate their level of agreement or disagreement with suggestions that homeowners should bear responsibility for mitigation actions or planning intended to reduce risk from wildfire.

We designed a mixed-mode survey administration approach that combined mail, online (Dilliman et al. 2014), and 'drop off, pick up' (DOPU) methods (Steele et al. 2001; Trentelman et al. 2016) in order to maximize potential participation by primary and secondary homeowners in the sample frame. We used county-level tax records from the assessor's offices in Valley and Adams Counties to identify whether each property was a primary or secondary residence. Mail survey administration involved a multi-step process as advised by Dillman et al. (2014) that consisted of: (1) an introductory letter; (2) a survey packet that contained an overview of the study, a copy of the questionnaire, and a business reply envelope; (3) a postcard reminder that included the option to complete the survey online; and (4) a final reminder letter. Each piece of mail was sent approximately one week

apart during June and July of 2016. Each questionnaire was assigned a unique geocode prior to distribution that allowed tracking of non-response addresses and to link responses in each of the geographic zones used in the GIS sampling procedure described above.

Researchers administered surveys to full-time residents using the DOPU approach during a two-week period in late June 2016. The DOPU approach entails delivering questionnaires to each household in person and arranging to collect completed surveys shortly thereafter (typically within the next 24 hours) (Steele et al. 2001; Trentelman et al. 2016). Researchers left a short flyer at households when residents were not in which outlined the purpose of the study and indicated that another attempt to deliver a questionnaire in-person would be made during the next 24 hours. Researchers revisited properties with notes every 24 hours to maximize attempts to administer the survey. They visited 840 households where a resident was at home and able to accept or decline to participate in the survey during the duration of fieldwork.

We received a total of 1,349 completed surveys between June 15th and November 29th, 2016 for an overall response rate of 48.8%. The DOPU approach yielded 669 completed surveys for a response rate of 79.6%, while the mail and online survey administration approach resulted in 680 completed surveys for a response rate of 35.3%. These response rates are somewhat higher than other recent wildfire surveys, particularly in rural areas.

3.3 Data analysis

Survey responses were analyzed using the quantitative data analysis software SPSS 24 (IBM 2016). We began by conducting an exploratory factor analysis on the 12 evacuation behavior statements, consistent with procedures outlined in Paveglio et al. (2014), in order

to explore variance or consistency in behaviors that often combine to characterize various evacuation behaviors or alternatives to evacuation. The factor analysis performed for this research used a Varimax rotation and a Kaiser normalization, and we retained resulting principle components whose Eigenvalues exceeded 1, in accordance with existing guidance (Field 2013, Stevens 2009). We included only survey respondents who answered all 12 evacuation statements, which provided a total of 1,138 responses for analysis. We then conducted a K-means cluster analysis using our output factor loadings to classify each respondent into one of three categories of intended evacuation behaviors, as dictated by the factor analysis described above. K-means clustering aggregates data into groups based on the proximity of each respondent to a cluster mean (Lattin et al. 2003).

We used Pearson's Chi square tests to explore whether there were statistically significant differences in a variety of binary independent variables across the three evacuation preference categories, including differences between mitigation efforts in the three areas of the HIZ and steps taken to plan for evacuation. Post-hoc z-tests with a Bonferroni correction were used to evaluate differences and similarities among variables across each evacuation group.

Finally, we conducted multinomial logit regressions to explore the relationship between the additional independent variables listed in Table 3.1 and the three evacuation preference categories uncovered in the early stages of the analysis to identify which variables may be predictors of intended behavior during wildfire. Multinomial logit regression is useful when the dependent variable is categorical, which is the case for our data (Vaske 2008). The three evacuation preference categories served as the dependent variable, with the evacuation preference group identified as the reference category because it

is the most commonly advocated response to imminent wildfire threat. Any binary variables included as independent variables in the multinomial logit regression were dummy coded before being entered into the regression. Preparation-based and event-based variables were initially combined into two composite measures, each with a Cronbach's alpha above .70. This indicates that they are reliable composite measures (Field 2013). However, our final multinomial logit regression included each event-based and preparation-based cue as a separate independent variable because both measures explained a significant amount of the variation in evacuation categories and we wanted to further explore the correlation of each factor on intended actions.

4. Results

4.1. Intended evacuation behaviors

Table 3.2 provides the mean responses to the 12 evacuation statements included in our analysis. More than half of all respondents moderately (32.5%) or strongly (27.1%) agreed that they would stay and defend their McCall-area property during fires. Approximately one third (33%) of respondents indicated that some residents in their household would evacuate while others stayed to defend the property. Results also suggest that residents intend to work with their neighbors during fire, with 49.3% indicating they would work with others to evacuate or to stay and defend (43.4%). However, a relatively high proportion of respondents strongly agreed (58.4%) or moderately (22.6%) agreed that they would evacuate when the authorities told them to do so. Approximately 4.9% of respondents moderately agreed, and 4.2% strongly agreed that they would remain at their property regardless of any evacuation orders from authorities. Instead, approximately 24.6% of respondents strongly agreed with the statement "I would wait to see how bad the fire is

and evacuate if I think it is too dangerous," while an additional 37.2% moderately agreed with the statement. Few residents (33.3%) planned to evacuate immediately after hearing about a fire that might affect their property (strongly agree =14.1%; moderately agree = 19.2%). If evacuated, 48% of respondents agreed that they would return shortly after to defend their property, while few respondents indicated that they did not know what they would do during a fire (moderately agree = 9.1%; strongly agree = 4.2%).

Results of the factor analysis revealed three principle components with eigenvalues greater than 1, and which collectively explained 55.16% of the total variance in the 12 evacuation behaviors (see Table 3.2). The Kaiser-Meyer-Olkin measure was 0.822, which indicates that our survey sample size was adequate, and the Bartlett's test of sphericity was highly significant (P = 0.000), resulting in rejection of the null hypothesis (Stevens 2009). The three evacuation preference categories determined by the k-means cluster analysis described in the previous section are: (1) Evacuate, (2) Stay and defend (SD), and (3) Don't know/shelter in place/ (don't know/SIP). Classification of respondents using the k-means cluster resulted in 54.0% (n = 614) of respondents in the evacuate category, 21.9% (n = 249) in SD category, and 24.1% (n = 275) in the don't know/SIP category. The results of our factor analysis and k-means cluster analysis closely match and extend results from Paveglio et al. (2014). The merging of two options to form the last group is supported by previous research that indicating that those without a plan are often left with no other option but to SIP if they do not act early enough (Paveglio et al. 2014; McLennan et al. 2013).

Respondents in the SD category displayed higher levels of agreement with the following intended actions: (1) remaining at home to help to defend property by putting out spot fires (rotated factor loading = 0.81); (2) traveling to their McCall-area property as

quickly as possible to defend it (rotated factor loading = 0.80); (3) working with their neighbors to stay and defend their properties (rotated factor loading = 0.79); and (4) that some household members would evacuate while others would remain to protect the property (rotated factor loading = 0.68). Respondents in the SD category also indicated less agreement with the idea of evacuating as soon as they heard about a fire that might impact their property (rotated factor loading = -0.66). SD respondents displayed high agreement with the statement "I would wait and see how bad the fire is and evacuate if I think it is too dangerous" (rotated factor loading = 0.61).

Respondents in the don't know/SIP group indicated are most likely to not know what do during a fire (rotated factor loading = 0.73). They also indicated greater consideration of remaining at home and safely sheltering without having to put out spot fires (rotated factor loading = 0.70) when compared to the other two groups. However, the mean response of -.71 to that question indicates that even this group are not inclined to shelter passively during fire. Respondents classified into the evacuation group were most likely to evacuate when the authorities told them to do so (rotated factor loading = 0.79). They also indicated that they would evacuate but return soon after the fire to defend their property from threats (rotated factor loading = 0.50), and that they would work with their neighbors to evacuate promptly (rotated factor loading = 0.63) (See Table 3.2).

4.2. Intended evacuation behavior and preparations for fire

Comparison across our evacuation preference groups indicated notable and significant differences in planning for evacuation actions prior to wildfire events. Performance of select mitigation actions in zone 1 of the HIZ also were significantly different across evacuation preference groups, while there were no statistically significant

differences between evacuation preference groups for mitigation actions undertaken in Zone 2 and Zone 3 of the HIZ. Table 3.3 summarizes significant findings across evacuation preference groups, and we provide detail on select comparisons below.

Respondents in the evacuation group were significantly more likely to have planned somewhere to stay during a long-term evacuation when compared to those intending to stay and defend (P = .000). Respondents in the evacuation and SD groups were more likely to have placed important documents and belongings in an easy to access place (P = .029). Residents in the don't know/SIP category were significantly less likely to have planned at least one route their household could use to evacuate when compared to the evacuation and stay and defend groups (P = .000). The number of respondents who had discussed their evacuation plans with neighbors was low across all groups, although those in the SD group were significantly less likely to have performed that planning action when compared to those who intended to evacuate (P = .036).

Respondents in the SD category were significantly more likely to have cleared or maintained a 30-foot green space around their property (P = .000) and to have spaced trees or shrubs at least 10 feet apart (P = .003) in Zone 1 of the HIZ when compared to the other two groups. Don't know/SIP respondents were statistically less likely to have removed branches of trees lower than ten feet from the ground in HIZ zone 1 when compared to the evacuation group, but not the SD group. Respondents in the SD group were more likely to have planted fire-resistant vegetation on their property (P = .014) when compared to the evacuation group, but could not be distinguished from the don't know/SIP group.

Respondents in the SD group were significantly more likely to have mitigations in place when they moved into their McCall area property. For example, respondents in the SD

category were more likely to have a 30-foot green space around the property when they moved as compared to the evacuation or don't know/SIP groups (P =.001). They also were significantly more likely than both the evacuation and don't know/SIP groups to have vegetation management in place on the property when they moved in (P =.013).

4.3. Influences on intended evacuation behavior during a wildfire

Results of our multinomial regression are outlined in Table 3.4. The model explains a statistically significant amount of variation in the dependent variable of evacuation group category (likelihood ratio X^2 = 395.3, P = .000). Male respondents were more likely than females to be in the stay and defend category when compared to evacuation while holding all other variables constant (β = .549, P = .016). Part-time respondents were significantly more likely to be in the evacuation category than the SD category (β = -.446, P = .033).

Select preparation-based cues also were significantly correlated with evacuation preference groups. SD respondents were more likely than those in the evacuation category to agree that decisions about evacuation would be affected by their ability to protect their property from fire impacts when compared to the evacuation category (β = .410, P = .001), all else constant. SD respondents also were significantly more likely to indicate that pre-fire mitigations influenced their evacuation decision-making (β = .272, P = .022). Respondents in the don't know/SIP category were more likely to consider fire professionals' ability to prevent damage on their private property when deciding whether or not to leave their property during wildfire (β = .292, P = .001), all else constant.

Statistically significant correlations in event-based cues differed most between SD and evacuation groups. Respondents in the SD category were less likely to consider their neighbors evacuation decisions when determining their preferences for evacuation or

alternatives to evacuation (β = -.225, *P* = .027), all else constant. Respondents in the SD category also indicated less consideration of formal evacuation notices in decisions to evacuate when compared to those in the evacuation category. Those findings related to both in-person evacuation notices from an emergency professional (β = -1.184, *P* = .000) and evacuation notices shared by the media (β = -.452, *P* = .000). Respondents in the don't know/SIP group were less likely to be influenced by in-person evacuation notices when compared to the evacuation category (β = -.707, *P* = .000).

5. Discussion

This research sought to explore the relationships between intended wildfire evacuation behaviors, pre-fire preparation activities, and event-based evacuation cues. We uncovered three predominant intended evacuation behaviors during a fire event: (1) evacuate; (2) stay and defend; and (3) don't know/shelter in place. A slight majority of respondents indicated a preference for evacuation if a wildfire threatened their property. However, a sizable portion of residents in the McCall area indicated that they would consider staying and defending.

We found significant differences in evacuation planning among respondents in each of the three predominant evacuation behavior groups that emerged from our analysis. We also found differences in wildfire risk reduction efforts at the property level across those groups, and evidence to suggest that pre-fire mitigation actions share a relationship with later evacuation behaviors. Finally, we found that members of each evacuation group will likely respond differently to preparation- or event-based evacuation cues and maintain different motivations for their actions. For instance, those in the evacuation group were heavily influenced by both in-person and media evacuation notices when compared to SD

and don't know/SIP respondents. Collectively the differences we found in respondents' intended behavior during wildfire, and in the factors that influence these decisions, indicate household or property level context prior to and during a fire event are likely to affect evacuation dynamics. These findings have implications for emergency management professionals and populations living in fire-prone landscapes, which we will outline below.

The three emergent groups resulting from our factor analysis of intended behaviors align well with commonly reported actions from existing literature (see Paveglio et al. 2014; McCaffrey and Rhodes 2009; Tibbits and Whittaker 2007; Strahan et al. 2018; McCaffrey et al. 2018). Therefore, our results provide further credence to existing efforts characterizing the range of resident behaviors during fire. Likewise, the results of our factor analysis were similar to those in Paveglio et al.'s (2014) study, indicating that the scales we adapted from that effort may be a reliable set of measures for exploring evacuation behaviors surrounding wildfire. This may be specifically true in forested regions of the U.S. West where both this research and that past research occurred.

We included three additional variables in our scales of evacuation behavior to explore the extension of measures used by Paveglio et al. (2014). Additional measures reflected nuances of potential evacuation behavior, including whether residents would travel to their property to defend it, whether they would work with neighbors to defend properties, and whether residents who evacuate would return to properties soon after to defend properties from threats (see McCaffrey and Rhodes 2009; Tibbits and Whittaker 2007). Results of our factor analysis indicate that these additional measures fit well with existing theoretical groupings of evacuation behavior, while they also provide important nuance about the specific ways in which residents plan to enact larger strategies. We would thus

suggest that our new measures usefully extend Paveglio et al.'s (2014) scale, especially given the expanding focus on the specific actions residents plan to take during fire and their utility in tailoring evacuation planning (Strahan et al. 2018; McCaffrey et al. 2018; McNeill et al. 2015), which we discuss later in this section.

Residents in our McCall sample were far more likely to evacuate when compared to the Flathead County residents surveyed in Paveglio et al.'s (2014) study, while the dominant preference of the latter population was to stay and defend. In some ways these results are not surprising, given that the McCall area is known more for its amenity migrants and second homeowners who our results suggest are more likely to evacuate, and who are less likely to have the skills or experience to fight fire on their properties (see Paveglio et al. 2018 for empirical evidence). Meanwhile, Paveglio et al.'s (2014) effort spanned all of Flathead County, including the rural portions of the county which contain residents with experience associated with forest management and firefighting. The comparison of our results to past studies are a good reminder that individual areas or communities may be populated by people with divergent approaches, experiences or preferences for addressing wildfire risk, including during the fire event itself (Paveglio et al. 2015a; Meldrum et al. 2018; Paveglio and Edgeley 2017). Diversity within each region studied also reinforces a need to focus on evacuation as an individual-level consideration that may be influenced by rapidly changing environments (e.g. other residents' actions, available information, etc.) and informed by event-based cues (McCaffrey et al. 2018).

Our results indicate support for 'wait and see' behaviors across all three evacuation preference groups evaluated in this effort. That result is similar to other wildfire evacuation studies, (e.g. McNeill et al. 2016, McCaffrey et al. 2018) and are thus a good reminder that

decision making about evacuation does not necessarily always result in a binary (yes/no) outcome. Instead, residents appear to consider behaviors during wildfires as a contingent decision that will always require some consideration of preparation and event-based cues—and which may change given the timing and circumstances associated with a given event (Whittaker et al. 2017). Therefore, we would suggest that it is likely more important to consider the *extent* to which residents 'wait and see,' and how event-based cues can influence the timing of decision-making about staying or leaving during fire, because almost any decision will include some elements of actively assessing the risk associated with an oncoming fire (Whittaker et al. 2013). For instance, few respondents in our sample (33%) agreed that they would immediately evacuate upon hearing about a fire in the area, despite the predominant advice of professionals and associated evacuation programs (e.g. Ready, Set, Go!, Stay and Defend or Leave Early) which stress how evacuation decision-making should occur as early as possible (Tibbits and Whittaker 2007; McCaffrey and Rhodes 2009).

Our exploration of the relationships between private property mitigations or planning and intended behavior during wildfires indicates that residents likely focus their pre-fire efforts on actions that support their predominant evacuation plans. For instance, we found that SD residents were more likely to have performed higher-effort fuel reduction mitigations such as clearing a green space around the home, spacing trees or shrubs at least 10 feet apart and planting fire-resistant plants around their residence when compared to those in the evacuate or don't know/SIP. Those behaviors seem conceptually linked with a decision to SD, as members of that group were significantly more likely to consider preparation-based cues of property defensibility and preparation in their decisions to remain

at home. Meanwhile, those in the evacuation group were more likely to have planned a long-term evacuation site, but not other mitigations that improve the survivability of structures in their absence. These findings provide some indication that motivation to perform mitigation may be higher if residents plan to remain at home during fires, and lower if they plan to evacuate (see also McCaffrey et al. 2018). Our result may be particularly important with regards to the don't know/SIP group, as they were the least likely to perform any mitigations and appear to be more reliant on firefighting efforts or warnings when making their decisions about safe actions to take during wildfires. Those in the don't know/SIP group may be a population who is not able or willing to mitigate personal fire risk, who could place additional burden on firefighting or emergency professionals during fire events, and who may be "free riding" off of other fire mitigation efforts by neglecting a shared responsibility of fire risk reduction to a larger population (Gan et al. 2015). Future research could further explore the attitudes of different evacuation preference groups with regards to responsibility for fire risk, or more explicitly implicate how their evacuation preferences influence the costs and benefits they associate with mitigation activities.

One interesting implication from our analysis is evidence that fire mitigation efforts might be self-reinforcing, or provide motivation to perform alternatives to evacuation, provided they are in place before residents obtain the property. That is, residents in the SD group reported a significantly higher level of pre-existing mitigation efforts in place when they moved into their McCall-area property, and also showed higher agreement with statements about maintaining or furthering property mitigation during the past ten years. Meanwhile, those who intended to evacuate or don't know/SIP noted that fewer mitigation actions had been undertaken prior to their arrival at that property. While our data cannot

demonstrate causality between pre-fire mitigations and motivation to stay and defend, it could suggest that some residents may place value on properties with significant wildfire mitigations already in place (e.g. forest clearing, fire resistant materials) and that initial performance of such activities when acquiring new properties may be preferred over performing them later (Paveglio et al. 2018). Our findings may also suggest that property regulations or policies encouraging or enforcing wildfire mitigation actions may be most successful when they are implemented before new property owners arrive. Future studies could further explore support for additional land use or building construction standards on new properties or when properties change ownership as one potential avenue for reducing wildfire risk in areas of the U.S. West.

Our analysis of preparation and event-based cues indicate a need for information tailoring or flexible guidance for populations planning divergent evacuation strategies or alternatives to evacuation. For instance, our results indicate that the evacuation group are more likely to be part-time residents looking for in-person notifications from professionals or the media about when to evacuate. The evacuation group also was likely to look to neighbors in making these decisions. Meanwhile, the SD group appears to be more resolute in their decisions and are less likely to be swayed by official warnings. Each group carries its own informational and management challenges. For instance, while attention and adherence to official evacuation warnings can be seen as a positive, reliance on others to inform evacuation decision-making can be paradoxical in that often there is not enough time for law enforcement professionals to conduct in-person warnings for every household at risk. Likewise, other researchers have observed residents' need to validate that their evacuation actions are appropriate during wildfire, or dependence on others to inform

personal decision-making (Mutch et al. 2011). The challenge with these trends is that residents may have prepared their properties differently for fire or may have planned to undertake specific actions that may not be feasible or safe for their neighbors to replicate. On the other hand, members of the SD group likely need information about the severity and intensity of the fire in the form of event-based cues indicating when fire conditions are extreme, and defense is less feasible. That information is better suited to that population because they are less likely to consider typical evacuation messages or pay attention to their neighbors (see also McCaffrey et al. 2018).

Tailoring warnings for residents planning different behaviors during fire would first require cataloging predominant intentions among broader populations, however the sheer magnitude of that effort may be implausible for many rural fire protection districts or counties of the U.S. West. Likewise, the diversity of resident responses and considerations implicated by our results and others (see Paveglio et al. 2015a; Steelman et al. 2015) indicates that efforts to craft one perfect set of messages to ensure advised evacuation behavior may be too idealist of a proposition. Instead, we would advocate that messaging surrounding evacuation stress careful resident consideration of wide-ranging preparation and event-based cues that they must adapt to their local situation. That information would not prescribe specific trigger points for evacuation or stress absolutism in decisions about alternatives to evacuation. Rather, it would encourage residents to assess a variety of plausible considerations and situations to use when evaluating the best decisions for the circumstances at hand.

Existing literature indicates that those without a defined plan during wildfire events are more likely to pursue late evacuation, which has been shown to increase the likelihood

of injury (Johnson et al. 2012; McNeill et al. 2015). Approximately one-quarter of residents in our sample indicated that they were unsure about their plans during a wildfire. The don't know/SIP group in our study also had given the least consideration to emergency planning, and were less likely to perform mitigation activities on their property when compared to the other two groups. These findings could be seen as troubling, especially because the don't know/SIP group also were the least responsive to event-based cues such as evacuation warnings, which makes it unclear exactly what would influence their ultimate decision about evacuation, alternatives or SIP. We would suggest that future studies specifically elicit or present a range of preparation or event-based cues among those who don't know what to do during a fire or who are considering SIP. That includes the factors that influence timing of evacuation among those who would fall into that category. A more detailed view of why and how residents choose (or default) to these evacuation preferences could lead to more viable strategies to reduce what are likely poor outcomes for safety.

6. Conclusion

Efforts to understand how residents plan for intended behaviors during wildfire and the influences driving these preferences are important components of emergency planning and risk reduction efforts in fire-prone communities. Findings from this study highlight the ambiguity and uncertainty associated with intended behaviors during wildfire and provide evidence suggesting that residents may change their plans during wildfire depending on their perceptions of event-based influences. They also are a good reminder that 'wait and see' activities are a matter of degree and timing—almost any resident action during fire will require some monitoring of the emergent situation and an evaluation of intended actions given the associated costs and benefits. Therefore, it is important to explore whether the

amount of time that residents wait still provides them ample opportunity to engage their plans safely, and that decision cannot be made by professionals alone. Both preparation-based cues and emergent event-based cues influencing intended evacuation behavior varied across groups identified in this survey, and suggest that there are close ties between mitigation efforts and intended behaviors.

Regardless of residents' intended behaviors during a wildfire event, it is important to remember that decisions to act upon those plans are largely contingent on the circumstances of each fire event and are subject to change depending on human interactions. This means that planning for different evacuation outcomes at the community and county levels is complex and hard to predict. Instead, there is a need to better prepare residents to make proactive, informed decisions before and during fire based on their own household's level of preparation and mitigation that consider, but are not reliant upon others' actions.

Table 3.1: Descriptions of independent variables collected using a survey of McCall-area households

		Descriptive statistics		
Variable (α)	**Variable definition**	***N***	**Range (response frequency)**	**Mean (SD)**
Age	Age of respondent	1085	21-93	60.6
Gender	Gender of respondent	1102	1 = Male (63.3%) 2 = Female (36.7%)	
Residency	Full-time or part-time resident (+/- 6 months per year)	1128	1 = Full time (53.7%) 0 = Part time (46.3%)	
Event-based evacuation cues (α = 0.760)	Whether I could see the flames The speed of the approaching fire An in-person evacuation notice from an emergency professional An evacuation notice shared by the media My neighbors' decision to evacuate The safety of other members in my household	1133	-2 = Very insignificant -1 = Moderately insignificant 0 = Neutral 1 = Moderately influential 2 = Very influential	1.2509
Preparation-based evacuation cues (α = 0.721)	My ability to protect my property from fire impacts How well prepared my property is to withstand wildfire damages The ability of fire professionals to prevent damages to my property My ability to evacuate without assistance	1132	-2 = Very insignificant -1 = Moderately insignificant 0 = Neutral 1 = Moderately influential 2 = Very influential	0.6992
Preparation for evacuation	I have discussed with my neighbors whether my household intends to evacuate I have planned at least one route for evacuation I have placed important documents and belongings in an easy to access place I have determined a location that household members would evacuate to	1134	0 = No 1 = Yes	0.5469
Trust in firefighting	I trust the local fire department to put out fires on my property I trust state agencies to put out fires on my property I trust Federal agencies to put out fires on my property	1122	-2 = Strongly disagree -1 = Moderately disagree 0 = Neither agree nor disagree 1 = Moderately agree 2 = Strongly agree	0.6181
Responsibility	Responsibility for protecting homes from wildfire lies primarily with the homeowner	1110	-2 = Strongly disagree -1 = Moderately disagree 0 = Neither agree nor disagree 1 = Moderately agree 2 = Strongly agree	0.70

Table 3.2: Mean Likert response by evacuation preference category.
Higher mean values are associated with greater agreement, where 2 = strongly agree and -2 = strongly disagree. Values in bold indicate which statements emerged as influential for evacuation preference groupings from the rotated factor analysis.

Variable	Evacuation (a)	Stay and defend (b)	Shelter in place/don't know (c)
I will evacuate when the authorities tell me to do so	**1.75**	-.06	1.25
My neighbors and I would work together to evacuate promptly	**.90**	-.29	.27
I would evacuate, but return soon after the fire to defend my property from threats	**.35**	-.57	.49
I would evacuate as soon as I hear about a fire that may impact my property	**.05**	-1.34	.14
I would remain at home and help defend my home by putting out spot fires	.10	**1.41**	.13
I would travel to my property as quickly as possible to defend it	-.13	**.97**	.10
I would wait to see how bad the wildfire is and evacuate if I think it is too dangerous	.20	**.63**	.74
My neighbors and I would work together to stay and defend our properties	-.35	**.49**	-.13
Some members of this household would evacuate and others would remain to protect the property	-.62	**.30**	-.37
I would remain at home regardless of authorities' evacuation orders	-1.84	**.02**	-1.16
I would remain at home and safely shelter in my home without having to put out spot fires	-1.89	-1.66	**-.71**
I would not know what to do during a wildfire	-1.29	-.96	**.33**
N	614	249	275

Table 3.3: Percentage performance and significant differences in actions to prepare for wildfire events across evacuation preference categories.

Subscripts indicate which evacuation preference categories differ at the 0.05 error level. Probabilities are significant at: *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$. Only variables with significant P-values are shown.

Variable	N	Evacuate (a)	Stay and defend (b)	SIP/Don't know (c)	X^2 (P-value)
Planning for evacuation					
I have discussed with my neighbors whether my household intends to evacuate	1132	4.9_{a}	1.2_{b}	$4.8_{a,b}$	.036*
I have placed important documents and belongings in an easy to access place	1123	60.2_{a}	61.8_{a}	51.7_{a}	.029*
I have planned at least one route my household could use to evacuate	1125	68.6_{a}	70.0_{a}	55.3_{b}	.000***
I have somewhere to stay during a long-term evacuation (i.e. more than a few days)	1133	87.8_{a}	78.2_{b}	77.2_{b}	.000***
Actions in place when the respondent moved into their McCall-area property					
A 30-foot area of "green space" was in place when I moved into my McCall-area property	1138	26.7_{a}	39.8_{b}	28.4_{a}	.001**
No vegetation management was in place when I moved into my McCall-area property	1138	57.5_{a}	47.4_{b}	58.5_{a}	.013*
Within 30 ft of the home (HIZ 1)					
I have removed branches of trees lower than 10 feet from the ground	1093	66.3_{a}	$65.5_{a,b}$	56.9_{b}	.026*
I have cleared or maintained a 30 foot "green space" around my home	1100	52.6_{a}	66.1_{b}	45.5_{a}	.000***
I have spaced trees or shrubs at least 10 feet apart	1059	29.6_{a}	39.6_{b}	26.1_{a}	.003**
Additional property measures					
I have planted fire-resistant plants around my residence	1132	10.5_{a}	17.8_{b}	$12.8_{a,b}$	.014*
I keep a fire extinguisher and other fire tools at this property	1132	78.1_{a}	$76.9_{a,b}$	69.7_{b}	.024*
I have created a water supply for firefighting	1132	35.7_{a}	$31.6_{a,b}$	26.3_{b}	.021*

Table 3.4: Results of multinomial logistic regression for variables affecting intended behavior during fire.

	Stay and defend vs. evacuate					Don't know/shelter in place vs. evacuate				
	Sig.	b(SE)	95% CI for Odds Ratio			Sig.	b(SE)	95% CI for Odds Ratio		
Independent variable			Lower	Odds Ratio	Upper			Lower	Odds Ratio	Upper
Demographic										
Age	.224	-.010 (.008)	.974	.990	1.006	.076	.012 (.007)	.999	1.012	1.026
Sex? (female to male)	.016*	.549 (.228)	1.108	1.731	2.704	.706	.064 (.170)	.764	1.066	1.489
Residency (full-time to part-time)	.033*	-.446 (.210)	.424	.640	.966	.486	-.117 (.168)	.639	.889	1.237
How influential or uninfluential are the following factors in your decision to evacuate:										
Preparation-based cues										
My ability to protect my property from fire impacts	.001**	.410 (.122)	1.186	1.507	1.913	.840	-.016 (.081)	.840	.984	1.152
How well prepared my property is to withstand wildfire damages	.022*	.272 (.119)	1.040	1.313	1.656	.474	-.060 (.084)	.799	.942	1.110
The ability of fire professionals to prevent damages to my property	.125	.175 (.114)	.953	1.191	1.490	.001**	.292 (.084)	1.135	1.339	1.580
My ability to evacuate without assistance	.881	-.014 (.095)	.818	.986	1.189	.927	-.007 (.072)	.863	.993	1.144
Event-based evacuation cues										
Whether I could see the flames	.072	.194 (.107)	.983	1.214	1.498	.180	.118 (.088)	.947	1.125	1.337
The speed of the approaching wildfire	.397	-.146 (.173)	.616	.864	1.212	.214	.192 (.154)	.895	1.212	1.639
An in-person evacuation notice from an emergency professional	.000***	-1.184 (.179)	.216	.306	.434	.000***	-.707 (.177)	.348	.493	.698
An evacuation notice shared by the media	.000***	-.452 (.113)	.510	.636	.794	.093	-.166 (.099)	.698	.847	1.028
My neighbors' decision to evacuate	.027*	-.225 (.102)	.654	.799	.975	.737	.028 (.082)	.875	1.028	1.208
The safety of other members in my household	.366	-.157 (.174)	.607	.854	1.202	.063	-.255 (.137)	.592	.775	1.014

Note: R^2 = .318 (Cox and Snell), .367 (Nagelkerke). Model $X^2(26) = 395.331$, p<.001
*P<.05, ** p<.01. *** p <.001
Evacuate is the reference category

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Chapter 4: Support for voluntary and regulatory approaches to wildfire risk reduction in two rural wildland-urban interface communities

1. Introduction

Formal requirements, local policies or ordinances are increasingly promoted as a plausible avenue for wildfire risk reduction among fire-prone populations. This includes calls to implement stricter land use planning and zoning restrictions in wildland-urban interface (WUI) areas (the area where dense human development lies adjacent to or intermixed with wildlands), limiting or prohibiting building in fire-prone landscapes, and providing incentives or levying fines that encourage vegetation mitigation or retrofitting of homes with fire-resistant materials (Syphard et al. 2013, Schoennagel et al. 2017). Narratives surrounding these regulatory methods for wildfire management on private lands promote formal approaches as a solution to combat residential impacts associated with rising frequency, size and impact of wildfires to communities in the United States, as well as an outlet for addressing the rising financial costs of firefighting and disaster recovery (Gorte 2013; Abatzoglou et al.2016; Mell et al. 2010). Discussions about regulatory approaches often center around increasing homeowner responsibility and accountability for wildfire risk reduction in the hope that small-scale efforts will contribute to community fire adaptation and changes in local culture around wildfire mitigation (Calkin et al. 2014; Abrams et al. 2015a). The outgrowth of such efforts offers opportunities to implement more sustainable and enduring approaches that are intertwined with community values and needs. However, little existing research examines citizen opinions surrounding various regulatory approaches on private lands that are targeted at reducing wildfire risk. Also missing is a more comprehensive explanation for whether such regulatory approaches would be supported and

effective in WUI communities. Understanding how specific communities might respond to increased oversight regarding property management and behavior in the WUI is essential to identify when and where such an approach might actually be implemented, and whether it can adequately address localized issues and concerns surrounding wildfire risk (Paveglio et al. 2018). This chapter explores community perspectives on regulatory approaches to wildfire management, with particular focus on identifying how drivers of support or opposition may differ among communities with differing local contexts.

Avenues for wildfire requirements, policies and ordinances are abundant at the county and city levels, but many communities in the U.S. do not reside within the boundaries that these regulations apply to or do not have a local government of their own to create and enforce regulatory approaches. Current arguments in support of regulatory approaches to wildfire on private lands often assume that their success in more suburban, dense WUI communities will translate to these more rural, dispersed, and sometimes unincorporated communities without critically considering the differing local contexts of these communities and the impacts that regulatory approaches may have on local adaptation to wildfire (Syphard et al. 2013; Abrams et al. 2015b; Moritz et al. 2014). The identity of many informal communities in the West are closely tied to self-regulation and independence, meaning that the introduction of unwanted or ill-fitting regulation has the potential to change local dynamics and create repercussions for community-agency relationships, place attachment, and collective action (Jakes et al. 2010; Mockrin et al. 2016; Prior and Eriksen 2013). There is stark evidence to suggest that heightened regulation is attainable in many WUI communities, particularly in rural areas where existing regulatory structures are often absent. Understanding support or opposition towards regulatory

approaches among more informal communities or those who currently experience little regulation can offer insights regarding the broader applicability and feasibility of regulatory approaches in the WUI.

The research presented here explores community members' perspectives surrounding the utility of regulatory approaches to wildfire management on or near private lands. More specifically, we investigate the specific elements of local social context that influence local stakeholders' perceptions about the utility of regulatory approaches to wildfire management through a series of focus groups in two unincorporated communities. Discussion about support or opposition regarding various wildfire management approaches in both communities focused on identifying both the effectiveness of voluntary and mandatory approaches for risk reduction and local acceptance for each approach. We also sought to identify approaches that community members felt were suitable alternatives for promoting collective action in instances where regulatory actions were not supported. This effort contributes to a broader body of literature that seeks to better understand how communities can be matched with a suite of wildfire risk management approaches that reflect local contexts in order to aid in the development of fire adapted communities. It also aims to explore how these local contexts influence collective action to address wildfire. We also seek to encourage discussion about the place of informal community approaches to wildfire risk reduction, and the role of community in decision making about wildfire regulation.

2. Literature review

2.1 Collective action and wildfire

Understanding and improving community adaptation to wildfire remains a central goal for identifying whether collective action is appropriate or possible to address wildfire.

However, approaches to community adaptation are likely to vary across the western U.S. as a result of differential ties between people and place (Prior and Eriksen 2013; Paveglio et al. 2009; Meldrum et al. 2018). For instance, Paveglio et al. (2018) outline nine broad considerations for adaptive or collective action when addressing wildfire risk, and discuss how specific strategies within each of those categories are likely to vary across locations with different social context. The research presented in this chapter focuses on identifying ties between community variations in support or opposition to regulatory or voluntary approaches by considering three influences outlined by Paveglio et al. (2018): (1) ways to promote property-level residential adaptation; (2) Governance model/structure of collaborative processes (i.e. the different ways that stakeholders may come together to address wildfire risk in an area); and (3) Adaptation leadership and relationships. It is important to note that approaches that are successful in one community may not transfer to another as a result of varying place-specific social conditions, but there are some broader trends that can help characterize different community responses (Paveglio et al. 2009, 2012, 2015). We briefly outline key elements underlying each of these three considerations as they relate to voluntary and regulatory approaches in the section below and their implications for wildfire adaptation.

One important component of efforts to encourage property-level adaptation entails consideration of whether voluntary actions or incentives or formalized regulatory approaches will be most effective and supported within a community (Reams et al. 2005; Berry et al. 2016; Paveglio et al. 2016). High rates of WUI expansion across the West during the last few decades have driven many states and counties to focus on regulatory efforts to address wildfire on land use planning and development in an attempt to preemptively limit

the amount of risk new communities may face (Gude et al. 2008; Syphard et al. 2013). Likewise, an increasing number of researchers, policymakers and fire managers advocate mandatory wildfire mitigations on private properties (e.g. vegetation management or fire-resistant building materials). Despite these findings, other evidence suggests that regulatory efforts are unlikely to be adopted, or may be actively opposed by some populations (Jakes et al. 2011, Abrams et al. 2015a, Steelman and Burke 2007). Existing research suggests that requirements surrounding wildfire mitigations are more successful in more suburban communities where similar regulatory approaches already exist (Paveglio et al. 2018; Abrams et al. 2015a). One alternative to regulatory action is the introduction of voluntary programs such as Firewise or Ready, Set, Go! that support more normative adoption of actions among residents or provide informational materials that can stimulate consistent action among community members who may have a limited understanding of or familiarity with wildfire (Paveglio and Kelly 2017; Absher and Vaske 2011; IAFC 2013). The voluntary approach to wildfire mitigation actions has been particularly successful among communities that already have some mechanism or group that promotes cohesion, including those that feature Homeowners' associations (HOAs), social clubs or networks (Winter et al. 2009. Existing research suggests that educational programs often are less effective in more rural or dispersed communities, particularly those with residents that may have firefighting, forestry or emergency management experience, or those who have developed self-sufficiency through the acquisition of skills and resources needed to manage their property (e.g. heavy equipment operators, chainsaw use, residential sprinklers). The success of more informal efforts for wildfire mitigation are more likely to depend on longitudinal support and commitment to actions that address wildfire (Brenkert-Smith 2010; Stidham et al.

2014). In rural or unincorporated communities, any partnerships between residents and professionals are more likely to be characterized by coordinated action, as members of such communities typically prefer to conduct some management actions themselves. Exploring what incentivizes collective action in these varying social contexts and identifying whether these approaches may be transferrable may offer an alternative to legally enforced regulation.

Support and opposition to regulatory or voluntary approaches associated with wildfire management actions often are influenced by past interactions or collaborations among residents. They also may be influenced by past interaction or collaboration between communities and outside organizations (e.g. support for a fuel break by an agency may depend on previous resident interactions with that agency) (Brenkert-Smith et al. 2006; Jakes et al. 2007; Carroll and Paveglio 2016). The presence or absence of rules or agreements that structure such collaborative efforts serve as a form of fire management governance, and can influence local dynamics and involvement in different types of adaptation efforts (Abrams et al. 2015a; Steelman 2016). In some instances, this entails the creation of policy or regulation at the federal, state, or local government level that enforces actions among households or communities, such as taxation to support emergency services or mandatory evacuation and roadblocks enforced with fines or legal action (Haines et al. 2008). Existing studies indicate that communities less likely to support voluntary mitigation actions may feature a high proportion of part-time populations, or feel that the responsibility for fire risk management primarily lies with fire professionals rather than residents. Additionally, regulation of fire mitigation behavior is often challenging in more rural, independent communities where a lack of government oversight may encourage grass-roots

action and community independence, and where some research suggests that trust in firefighting agencies is low. In such communities, collaborative actions are more likely to begin at the local level and in more informal capacities, such as the establishment of social norms that are enforced through peer pressure to comply in order to 'belong' to that community. Other informal efforts to address risk may include communication networks such as phone trees or plans to use personal equipment to fight fire in the absence of professional capacity (Paveglio et al. 2015a). Programs such as the Community Wildfire Protection Plans (CWPPs) serve as somewhat of a hybrid between voluntary and formally regulated approaches to mitigation by creating opportunities for structured collaboration and a venue for formal agreements about fuels reduction at a county or sub-county scale (Jakes et al. 2007). Creating avenues for community-led regulation like CWPPs offers opportunities to increase local responsibility for wildfire risk and foster partnerships for management between communities and fire professionals (Williams et al. 2012; Lachapelle and McCool 2012).

Additional research illuminates how the organization of leadership surrounding wildfire adaptation or mitigation actions can have an important influence on any collection action. Support or enaction of voluntary or formally regulated approaches may hinge significantly around convening, organization or oversight by a leader or organization that is trusted among residents and which can achieve collaboration among diverse interests (Absher and Vaske 2011). One approach for introducing new risk reduction actions may be to channel them through existing individuals or groups that are trusted in the community, but the success of that strategy must also respond to local social conditions. For example, the presence of a local champion or a HOA that is already serving residents in other capacities

may be the preferred outlet because it is localized, trusted and familiar, or that existing formal regulation through that organization has been successful (Stidham et al. 2014; Paveglio et al. 2017).

Mismatches or disagreement about approaches to wildfire management can lead to loss of trust and strained citizen-agency relationships. This can occur when regulations such as burn bans are not implemented consistently by a governing agency, or there is confusion about the same regulation at different scales such as at the county and HOA levels (Hann and Burnell 2001). Evaluating the successes and pitfalls of existing collaborative efforts to address wildfire in diverse locations provide one avenue to develop insight and guidance that community members and professionals can adapt to their situation when considering whether or not to adopt or introduce new approaches to wildfire risk reduction.

In summation, there is limited research that examines the factors influencing cross-community variation in support or adoption of voluntary or regulatory approaches, and the degree to which those outcomes are influenced by local social context that dictates the form or function of adaptation, governance and leadership. Understandings of the factors that may influence these differences in support or opposition towards voluntary or involuntary efforts also is valuable for better pairing communities with appropriate policies and management approaches. Furthermore, there is a need to understand how and if elements of local social context interact with each other to influence collective action at the community level. The following section reviews existing research on characteristics that help explain community ability to adapt to wildfire and discusses how these efforts reflect community diversity in the WUI. It also outlines current understandings of community diversity and support or opposition regarding different types of regulatory approaches.

2.2 Local contexts and regulatory approaches to wildfire

There are growing concerns that existing regulatory or management approaches for addressing wildfire in the U.S. are not designed with social diversity across the WUI in mind, and that they may lack the flexibility needed to address the diverse local social contexts that make up the ever-expanding populations of private landowners influencing the complexity of wildfire management. A growing body of research highlights the need for wildfire risk management approaches to be adjusted or tailored to meet the needs of WUI communities with different local contexts. Recent efforts to understand and accommodate variable community support for or capacity to implement voluntary or regulatory management approaches seek to minimize hurdles to community wildfire adaptation. One such effort is provided by Paveglio et al. (2018) who outline adaptive capacity 'pathways' that may help streamline policy design and management approaches for four different characterizations of WUI communities. These authors note how existing approaches for reducing wildfire risk across different scales can lead to the formation of conflicting "micro-habitats" for regulation. Wider recognition of disparate approaches to fire within the same geographic area has heightened the need for acknowledgement and consideration of diverse WUI populations, particularly when planning or implementing larger-scale efforts to address environmental conditions and risk (Brenkert-Smith et al. 2012; Paveglio et al. 2018; Meldrum et al. 2018).

Existing research indicates that residents' support and action surrounding wildfire mitigation or adaptation efforts can be understood as a product of evolving local context. The evolution of that action is a product of changing relationships among residents or between communities and professionals, social change, the experience of past fires, and

changes in landscape processes (e.g. buildup of fuels or climate change) (Paveglio et al. 2016). Paveglio et al. (2009; 2012) identify four broad conceptual elements of WUI community adaptive capacity: (1) Demographic/structural characteristics; (2) place-based knowledge/experience; (3) Informal interactions/relationships among residents; and (4) access to scientific/technical knowledge networks. Nested within each of these four categories are 21 distinct characteristics (shown in Figure 3.1) that combine to help to explain how communities differ in their approaches to and actions in response to wildfire risk. Characteristics implicated in what is called the Interactional Approach to Adaptive Capacity include the presence or absence of community organizations like HOA/POAs, local relationships with government agencies, presence of part-time residents, and existing skills held by residents in a community that may be helpful in addressing wildfire risk reduction. The combination of characteristics present in each community provides a narrative of conditions that help explain why community members have, or are likely to respond to, wildfire adaptation strategies and policies, including voluntary or regulatory approaches to adaptive action. Paveglio et al.'s approach implies that WUI communities are continually evolving and interacting with other local or extra-local processes to drive changes the capacities that local people can mobilize to adapt to stressors such as wildfire. That approach also offers a structure that researchers, managers, and policymakers can use to assess local needs and preferences regarding wildfire management.

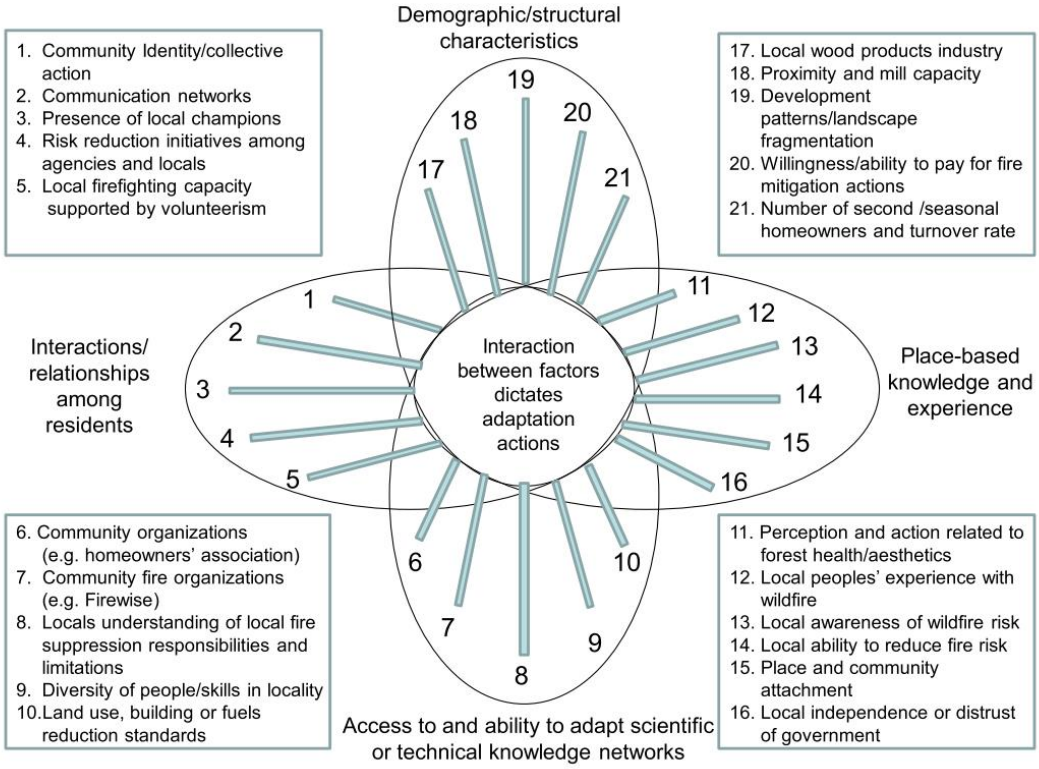

Figure 4.1: *Characteristics influencing adaptive capacity to wildfire in WUI communities (Paveglio et al. 2012; Paveglio and Edgeley 2017).*

Existing efforts to study social diversity in the WUI have typically focused on the range of different actions that communities might take to address risk (i.e. voluntary actions), rather than actions being imposed on them by regulatory bodies (i.e. regulatory actions) (see Brenkert-Smith 2011, Kelly et al. 2008, Jakes et al. 2011, and Paveglio et al. 2009 for examples). Uncovering the influences on local preferences for fire management, including potential or actual responses to regulatory wildfire mitigation or adaptation strategies offers one opportunity to streamline risk reduction efforts and foster shared management of risk among citizens and agencies (Berkes 2009, Paveglio et al. 2015b). Improving shared management of wildfire and promoting policy flexibility to accommodate for these different contexts may play a key role in producing sustainable approaches to

'living with fire' (Paveglio et al. 2018). This study aims to address the needs outlined above by exploring how existing local conditions in two socially distinct WUI communities influence support or opposition for voluntary and regulatory approaches. We also seek to identify which alternatives residents would support alongside or the place of regulation, and what characterizes this support. We use the characteristics of adaptive capacity as outlined by Paveglio et al. (2012, 2017) to analyze focus group data from two rural communities in Wyoming and Utah in order to address the following research question: *What factors influence support or opposition for formal wildfire regulation in Story and Timber Lakes?*

3. Methods

3.1 Study site selection

We sought to identify two distinct communities in different regions with potential variability in local social context that might influence wildfire. Researchers began the site selection process by compiling a list of WUI communities in Western states that are not often represented in existing social research on fire. Wyoming and Utah emerged as good candidates for underrepresentation. Researchers collected preliminary information about site selection from multiple sources to help identify each potential area, including Google Maps, city and county web pages, land use data and local news articles. Indicators of social context likely to shape each of the potential site locations included the presence of local businesses or operations such as timber mills or recreational facilities, access to amenities and recreation opportunities, and presence of absence of ongoing efforts to address fire risk. Researchers then conducted semi-structured telephone interviews with key informants from a shortlisted set of potential case study communities in both Wyoming and Utah, including local officials, emergency management professionals, and community leaders. Initial

questions asked of key informants during this screening process included description of interactions among residents and agencies and description of local peoples' attitudes and approaches to wildfire risk management.

Two communities emerged as potential study areas for this research: Story, Wyoming, and Timber Lakes, Utah. Story is situated in the Bighorn Mountains and surrounded by the Bighorn National Forest. Approximately 828 people live in the Story area year-round (U.S. Census Bureau 2010). A project to construct a fuel break around the town has been ongoing since 2004 (Sheridan County 2014). Forested areas surrounding Story are predominantly characterized by lodgepole pine, intermixed with with other coniferous species like ponderosa pine. There is a small HOA within the community that is predominantly populated by newer residents or second home owners. The Story area has limited ingress and egress and is supported by a small local volunteer fire department

Timber Lakes is a gated community of 607 full-time residents overlooking the Wasatch Mountains, consisting of approximately 800 developed and 200 undeveloped lots. It lies several miles east of Heber City, which has a population of approximately 15,800 people (U.S. Census Bureau 2010). The community has direct access to state recreational lands and is in close proximity to the Uinta-Wasatch-Cache National Forest. The Timber Lakes community features an assortment of common areas that include lakes and trailheads to snowmobiling trails. The northern end of the community is populated by scrub oak, while the southern end is characterized by aspen. The Timber Lakes Property Owners' Association (POA) collects annual fees to maintain roads and fund security measures in the area, serving a similar purpose to a HOA. Both Story and Timber Lakes are unincorporated, meaning that they are not overseen by a formal city government. Neither community has been directly

impacted by a wildfire in recent years, but other communities in close proximity have reported property losses during local fire events.

3.2 Focus groups

Researchers conducted a total of eight focus groups with residents and professionals in both communities, collecting data in Story during August 2017 and in Timber Lakes during January 2018. They conducted four focus groups in each location, with three focus groups in each location comprised of residents and one focus group in each location comprised of professionals. Residents and professionals participated in separate focus groups in order to allow both groups to speak openly about one another and not be concerned with social desirability associated with potential conflicts among stakeholders in the area (Fisher 1993). A total of 44 residents and professionals participated at Timber Lakes, in addition to 45 participants in Story. Focus groups sessions lasted between 1 hour and 40 minutes and 2 hours and 15 minutes.

Professionals and local community members contacted to take part in the focus groups were identified using theoretical sampling, which seeks individuals with specific knowledge about the topic of interest in each community (Charmaz 2000, Bryman 2012). Professionals sought to take part in the focus groups included land management agency employees, fuel and fire mitigation experts, government officials, and local emergency management (including the County Sheriff's office and local fire department). Participants selected to participate in the focus groups were chosen for their potential insight on current efforts to address wildfire risk and how community residents have interacted with professionals to inform management decisions.

Community members sought for participation in the focus groups were identified through local social organizations, and through internet searches to identify relevant local news stories that featured residents. These individuals were then asked to identify other residents who have similar or contrasting opinions about fire management in a process known as snowball sampling (Biernacki and Waldorf 1991, Lindlof and Taylor 2010). Researchers also recruited resident participants in person in the days leading up to the focus groups by intercepting residents in popular community areas and by knocking door-to door at households throughout each community. This systematic approach to recruiting participants ensured that a representative cross-section of participants had the opportunity to attend, and that participants were fully representative of the area.

Researchers designed a mixed-method protocol that included interactive rating of potential wildfire adaptation strategies and more traditional semi-structured questions designed to illicit conversation among research subjects. Participants were first asked to characterize the community in their own words, before identifying where residents in that community live on a map of the broader area. Participants next answered several sets of 5-point Likert-scale questions assessing a range of different management scenarios, approaches or policies for their community based on two concomitant criteria: (1) effectiveness for risk reduction; and (2) whether it would be supported by or implemented by residents and professionals in the area. Each suggested management scenario, approach or policy included in the focus groups was based on findings and recommendations from an extensive body of existing literature regarding community preferences surrounding wildfire risk reduction efforts. These management approaches fell under several broad categories, including: (1) regulations and incentives (e.g., Jakes et al. 2011); (2) responsibility for risk

management (e.g., Olsen and Shindler 2010); and (3) mitigation efforts at the household and community level (e.g., Paveglio and Kelly 2017). Participants each used a personal electronic response card or 'clicker'– electronic remotes that allow the holder to cast votes by pressing the appropriate buttons. Such clickers are a common tool for encouraging participation among larger groups of people and offer an opportunity for rapid data collection (Stowell and Nelson 2007). Responses were recorded in real-time, allowing facilitators and participants to track voting progress and see results on a projector screen. Researchers then used visual outputs to invite discussion about reasons for support or opposition for each approach given the specific context of the community.

3.3 Analysis

Each focus group was recorded with the permission of participants and later transcribed verbatim. Researchers discussed emergent themes after every focus group, which were used to guide the first step of the coding process. All subsequent qualitative analysis was conducted in QSR NVivo. Two iterative rounds of coding characterized the bulk of the analysis process. First, segments of transcripts were coded based on any indication of 21 adaptive capacity characteristics outlined in Paveglio et al. (2012, 2015, 2018). This phase of the analysis effort closely resembles topic coding and utilized to descriptions provided in Paveglio et al. (2015: p302). The second round of coding used results from the first phase to identify explanations or justifications for participant support or opposition to each management approach, regulation, or policy introduced in discussions guided by the Likert-scale questions. This second phase of analysis utilized a combination of analytic induction and thematic analysis to develop descriptive codes (Ryan and Bernard 2000, Gibbs 2007). Combining the two coding phases enabled the identification and

characterization of final themes. Both researchers coded a subset of randomly selected transcripts to ensure intercoder reliability (Saldaña 2016). Finally, representative quotations were identified and agreed upon by both researchers (Boyatzis 1998).

4. Results

4.1. Drivers of community opposition to regulation

Both Story and Timber Lakes residents described themselves as vehemently against regulation in their communities as a result of previous experiences with regulation or government entities. However, the specific reasons for that lack of support for formal regulations reflected specific and divergent local context in both areas. Story residents described themselves as a "lawless group" that shared one commonality: their desire to escape government overreach. Many shared their experiences living in other parts of the U.S. that included more regulation on their lifestyle or private property and identified the absence of private property regulations as a dominant factor in their decision to move to Story. Residents in Story often did not distinguish between federal, state, or local governments, but rather saw them as one united "government" entity that restricted resident behavior. As one Story resident summarized:

> *One of the primary reasons I moved here is that we're very far away from the rest of the world, and it's very beautiful. But the [other reason] is there's a lot less government. So I think the sentiment, don't you guys agree, in this community is: Nobody tells me what to do. I'm out here away from government. We don't want government telling us what to do, how to run our lives. I think that's a dominant attitude.*

Several focus group participants voiced concerns that the introduction of any government-enforced regulation would change their way of life and lessen residents' interest in continuing to live in the area. While Story featured an absence of formal rules or entities that would regulate wildfire mitigation or adaptation actions, participants did describe underlying social norms that encouraged certain risk reduction behaviors. Residents discussed acting as informal regulators by talking with their neighbors and new residents in the area about enacting efforts to reduce risk on their property, explaining how that adherence to actions was common sense and tied to their community identity as self-sufficient people. This included conversations about creating defensible space, removing hazardous vegetation, and evacuation planning. Ensuring that new residents or the small, but growing segment of second homeowners in Story adopted locally agreed upon principles for risk reduction was described as a priority among focus group participants. Encouraging mitigation actions on private property was described as a necessary alternative that could stave off formalized collective action in a community that values independence. One resident explained:

> *I kind of understand Story more as an identity than a community. We don't get together in large groups and enjoy each other very much, but we're very proud to say we're from Story. Step outside the community limits. So how do you appeal to that identity issue? A good Story person doesn't burn in the summer. A good Story person cleans up your block. A good Story person, you know? Puts a tin roof on, or whatever. Maybe a better approach than anything that tries to do more organized, get people together kind of thing. Because I don't think you're gonna get people together here, we're just too contrary and we're too independent. If you're here, it's the kind of person you are.*

Residents in Timber lakes described opposition to regulatory approaches as explicitly tied to historic interactions community members have had with their local county government. Residents felt overlooked by the county, particularly regarding access to public services and emergency response. Residents described Timber Lakes as a significant and long-term contributor to the county tax base yet felt that they saw little benefit to their community in return, particularly in terms of access to public services such as professional response to medical emergencies. Much of the reported distrust between residents in Timber Lakes and representatives of the county emergency services, firefighting agencies or county commissioners revolved around the construction of a small fire station that had been built in Timber Lakes several years prior on land donated to the county by the POA. The station houses an engine but is not manned and primarily serves as a staging area for firefighters travelling from the Heber City fire department approximately a 20-minute drive away. Although residents described themselves as being grateful for the fire station, the absence of trained professionals and a perceived legacy of strained relationships with those who would respond raised concerns about safety in the community, with one resident explaining: "*Even if there is a fire in Timber Lakes, the firefighters are not going to respond from Heber to the fire station in Timber Lakes. So, the fire station in Timber Lakes is eye candy."* Residents felt that their experience with the fire station was exemplary of the county oversight of Timber Lakes:

> *I do feel like we're really underrepresented. Somebody, it was a realtor, went through and figured out that we provide something like 15 percent of the tax revenue for Wasatch County. And, I mean, that's an awful lot, and I don't think we get a whole lot of representation in the county. I mean, we're sort of the red-headed*

> *stepchild. We have our own first responders out here. We have a fire station with no firemen and no equipment… I don't think that's right with the amount of revenue we provide.*

Residents felt that the county would not be a trustworthy or unbiased regulator for their community based on these ongoing interactions. However, they were more willing to consider regulation if it was introduced by federal or state bodies such as the U.S. Forest Service or the Utah Division of Fire, Forestry and State Lands. As one resident described:

> *I don't care who it is, just help…They couldn't do worse than what we've done. I mean, to let a cabin burn to the ground, I think we can do better than that and I don't care who it is. If any one of those groups would get together we could do better than that.*

Residents and professionals described the Timber Lakes POA as a plausible avenue for implementing future wildfire regulations in that community. These participants hoped that the presence of an existing regulatory structure could engender consistent community compliance the POA represented local control and was seen and more trustworthy than county governments. However, respondents also felt that the POA would need to adapt to better represent residents and improve its ability to implement existing regulations such as the consistent enforcement of burn bans. Focus group participants indicated that they had reported other residents who breached fire pit or burn ban regulations to the POA with little effect or repercussions. They also described inconsistencies in the timing of burn bans across the POA, county, and National Forest had created confusion about when it was safe to burn.

Residents and professionals in both Timber Lakes and Story described ongoing social change within their populations, with particular attention paid to increasing numbers of second-home or absentee land-owners who displayed different priorities and values associated with fire management and risk mitigation. More specifically, residents in both communities described some newcomers as being either: (1) unaware of wildfire risk and normative risk reduction practices already existing in the each community; or (2) who did not plan to support or implement mitigation measures because it was of lesser concern to them, often citing the presence of insurance on their property or additional primary homes elsewhere. The perception of these seemingly differing attitudes motivated primary homeowners or longer-term residents focus on the need for additional regulations related to managing actions on new or part-time residents' properties. The existing presence of and familiarity with the POA in Timber Lakes led residents to support enforcement any new regulation using this existing platform. As one resident explained:

> *I think if there were proper requirements, and reasonable requirements, that there is definitely people who don't want to be told what to do with their land, but the reality is when they sign up to purchase a lot in Timber Lakes, or in any community, there are CC&Rs. Our CC&Rs aren't all that great, but they can be enforced. So, I think if you said, "You have to do this, that, and the other thing. Can't have a tree touching your roof."… If they were to say, "Hey, here's the new rules. You have to have 10 feet around your house. Can't store firewood on your deck."*

Ongoing conversations about wildfire management in both Story and Timber Lakes included discussion of formal incorporation of each area as a census designated city. This change had the potential to instill a formal government for the area that could regulate various aspects of

shared or private property and open up avenues for access to other management resources. Efforts toward incorporation were met with opposition in both locations, though for differing reasons and to a differing degree.

Residents and professionals in Story outlined how the growing part-time population of residents expected access to urban services such as garbage disposal and that growing development would require better infrastructure. However, while incorporation could help achieve these needs, it would fundamentally change the identity of the community by creating a greater dependence on government entities and sacrificing some of that local-level control and independence. Story residents' distrust in government led them to believe that this approach would not be as effective as they would like. As one Story resident explained: "*By adding more government to try to solve the problem that this community has, I just don't have faith that government is gonna actually be a plus."* Professionals who served Story also expressed lesser need for incorporation, because of the ongoing success of different agencies to work together with the community:

> *It's the cooperator relations that have been fostered between State, Federal, County governments. That everybody's pitching the same message, that we all feel like we work together well as a team. So, it's easier with the approach to the general public when everybody has a good working relationship across those agency fence boundaries.*

While Story residents described independent efforts to self-regulated mitigation actions and found themselves supported by government entities in this approach, residents in Timber Lakes were so socially diverse that professionals and residents felt that voluntary collective action to address wildfire risk was unlikely to be consistent. Professionals in the Timber

Lakes indicated that residents in the area needed to strengthen some common organization or governing body that would allow for more consistent or enforceable standards in the absence of shared norms:

> *Until Timber Lakes wants to become more cohesive as a community, I don't see any of these programs creating enough interest to want to do them. If they were to incorporate I would think that would be great, because they would have to then somewhat come together and they would have some common goals of some things, and some responsibilities.*

While residents in both Timber Lakes and Story preferred informal organization of wildfire adaptation strategies and had less support for formal government, they were supportive of certain government programs designed to assist local landowners. For instance, residents in Timber Lakes were highly supportive of an invasive thistle spraying program organized by the county, primarily because the county provided equipment and chemicals while residents contributed their time and effort to the project on their private property or common areas. Those who did not remove thistles could potentially receive fines. Residents indicated that support for this program stemmed from the flexibility to lead their own efforts at little cost, and because they were able to see negative consequences enforced by those who did not abide. Story residents strongly supported U.S. Forest Service efforts to create a large fuel break around their community. While the effort used federal funds to conduct the work, residents were willing to have some of that work performed on private lands abutting their Forest Service neighbors in order to protect the larger community. Professionals had initiated a similar fuel break effort in Timber Lakes, but greater resistance to fuel reduction on private property meant that implementation had been

an ongoing process. Members of both communities voiced aspirations to maintain their fuel breaks primarily through access to addition federal funding.

4.2 Conditions for support to regulatory approaches

Residential and professional focus group participants indicated that the financial burden of wildfire risk reduction on private property represented a significant barrier to independence in both communities. Residents struggled to justify the costs of vegetation management or retrofitting to their properties, despite the potential risk posed by future fires. Many explained that an inability to pay for mitigation left them reliant on financial assistance in the form of cost-share programs or grants from government agencies. Participants described how this reliance on cost-share programs caused some cognitive dissonance among people who wanted to be independent, but that the programs could be a motivating factor for those who were unsure about whether to conduct mitigations on their property. As one Story resident explained:

> *One thing I would say, the cost is a very important matter. I mentioned earlier before we started that I took advantage of some kind of a government-funded effort to help me thin stuff out at my property. And I admit if I didn't get that money, I probably wouldn't have done that.*

Beyond financial incentives, residents in Timber Lakes and Story both described reductions in their insurance premiums as a potentially viable incentive that could catalyze risk reduction activities on their property. However, residents worried that the insurance industry might not find such programs profitable in states like Wyoming and Utah.

Residents did indicate some support for additional taxation provided that it would be used specifically for work in Timber Lakes or could allow for the employment of fire professionals who would be based out of their fire station. Story residents also were interested in additional taxation to support their already established local volunteer fire department but focused instead on expanding existing capacity rather than establish it, as was the case in Timber Lakes. Story residents hoped that additional income from taxes could be used to assist with training and to station full-time personnel during summer months who could conduct outreach with residents.

Several focus group participants in Timber Lakes expressed interest in training to become a volunteer fire fighter for their community in order to access equipment in their local fire station and to generate greater local benefit from the fire station. However, they cited the level of commitment – approximately 1,500 hours of training - as a barrier to their participation. In response, several community members had formed a Citizen Emergency Response Team (CERT) consisting of residents who were trained in first aid and could act as first responders to community emergencies until professionals arrived. Members of the CERT hoped that by increasing their team capacity and recruiting new members, they could increase their local capacity to respond while reducing their dependence on county-level officials.

4.3 Adapting management to meet community needs

Focus group communities differed in their preferences for local leadership of wildfire risk reduction efforts and the way in which those leaders should interface with other partners. In Story, pushing regulatory approaches or new management actions through the volunteer fire department was described as most appropriate to participants, as this was

considered the most ‘formal’ and trustworthy organization currently within the community. As such, participants described the volunteer fire department as the most effective outlet for spreading messages and action through the community. One participant summarized this sentiment as such:

> *The most cohesive force we have in the community is our fire department. The community will support it. Having said that, our fire department's very small. We need to figure out a way to augment the fire department. Then you figure out a way to have some of more seasoned citizens carry on somebody's functions such as communication, fire mitigation point.*

Participants in Timber Lakes described a slightly higher resident tolerance for regulatory approaches due to required compliance of their POA CC&Rs. They indicated that the best and most effective avenue for introducing and implementing regulation in the community entailed amendments or additions to their CC&Rs. That process would not be easy, however, because changes require a vote, and a certain percentage of homeowners had to submit a ballot for the initiative to pass—the latter of which was increasingly difficult in a community that features a large contingent of absentee or second-home owners. Residents and professionals discussed the need to identify a community leader or committee who would take responsibility for wildfire-related issues within the POA, but were unsure who this individual would be. Participants discussed the need for ‘neighborhood captains’ who could informally organize a small subsection of the community to address fire. Each captain’s responsibilities might include engaging neighbors in discussion about mitigation or ensuring the safety of those nearby during evacuation.

> *If we had it organized, if you have, like, a chief on this section of road. Like you would do Birch and we would do Greenbrier and you're like making sure that the people on your road were aware of where is your closest fire exit… There's more of a sense of community now…*

Residents in both communities expressed a desire to see their appointed 'leaders' take charge of public education about wildfire risk reduction. Education was frequently viewed as a suitable alternative to regulation, as representatives from both communities indicated that issues with wildfire risk reduction were caused by a lack of awareness among second homeowners or visitors. They felt that education would encourage greater action, and that this approach was feasible moving forward. Story residents and professionals indicated that education about evacuation, including possible routes and decision-making about timing, would be most beneficial for their community as the area had limited ingress and egress. In addition to evacuation, those in Timber Lakes were also interested in understanding potential fire behavior and areas of higher risk in their valley in order to target areas for hazardous fuel reduction and to motivate homeowners to take voluntary action. Regulatory approaches were considered more of a 'last resort' to force residents into taking action and felt that leading with education might overcome the need for regulation. As one resident in Timber lakes explained:

> *We can put together, we've done it on other projects, we can put together a grassroots project that would probably save ourselves. Starting even with awareness, like John said, just people knowing, or saying, "Hey, here's the things that you can do." You can't force everybody to do it. But we can get started.*

5. Discussion

This research sought to better understand support or opposition to voluntary and regulatory approaches for wildfire management in two unincorporated communities. We also were interested in exploring how that support or opposition is influenced by different elements of local context operating in those communities. We found that residents in both Story, WY, and Timber Lakes, UT, opposed regulation in various forms as a consequence of varied previous interactions with government and negative experiences with existing regulations. However, each population was willing to support some regulatory approaches that were specifically tailored to their communities, especially if those efforts allowed them the opportunity to act at the local level, govern efforts themselves, and produced visible benefits for their community. We discuss these and other insights from the research in the following sections and provide suggestions for encouraging collective action in similar circumstances.

Support for certain types of property-level adaptation in both communities was tied to existing interactions or collaborations (including the lack of collaboration) with extra-local organizations. Members of Timber Lakes were more willing to support restrictions on their property if it was required through POA CC&Rs and implemented in a consistent manner. Distrust in the county government fostered interest in channeling risk reduction efforts through the POA, creating a locally-driven effort to address wildfire that is similar to those observed in other communities with their own regulatory boards (Winter et al. 2009; Stidham et al. 2014). Absence of a local government in Story led residents to support more incentivized approaches such as tax breaks or reductions in insurance premiums. The opposition towards any effort that penalized resident actions in Story reflected and is driven

by their shared identity as a ‘lawless’ population. Residents did not want to have their actions restricted as a consequence of previous experiences and displayed little interest in collaborative efforts beyond their community as a result. This example illustrates how the specific form of adaptation leadership and relationships, preferred structure of collaboration, and ultimate form of preferred property-level residential adaptation are the product of site-specific interactions that influence community-level support for wildfire management approaches. The results presented here provide location-specific examples for how these processes may play out, and contribute to the broader wildfire social science literature by emphasizing the temporal connectivity of those underlying influences among WUI populations.

Local independence in both Story and Timber Lakes evolved as a product of distrust towards government. Informal efforts to address wildfire risk were most prominent in Story as a result of resident interactions with government organizations from different areas of the U.S. Enduring social norms regarding fire risk reduction among residents aligned with a drive to be independent from government at any level. This supports other literature that discusses similar rural, unincorporated communities and their successes with sustained and informal self-regulation that was deeply rooted in the character of informal communities (Paveglio et al. 2015a; Jakes et al. 2010). While efforts to remain independent in Story increased local capacity and collective action, Timber Lakes residents’ lack of collaboration with county government led to reduced avenues to reduce fire risk, as they did not have access to the resources they felt they needed to improve local capacity. Conflict or disagreement with government entities has been found to create long-lasting impacts on collaboration and community adaptation to wildfire in other rural U.S. communities

(Edgeley and Paveglio 2017; Paveglio et al. 2015b; Carroll et al. 2011). Our cases indicate how absence of collaboration with extra-local organizations has limited access to risk-reduction resources, requiring residents to exploring routes to self-sufficiency that reduce government dependence.

Residents in both communities were willing to support both voluntary and regulatory approaches if they felt that the benefits outweigh the costs to their area. Regulatory approaches had to provide a tangible or visible positive outcome for themselves or their community that could increase local through the provision of new or improved resources. Support for regulatory approaches based on whether residents feel that effort is fair in both its application and its outcomes has been identified in other US research on community mitigation (e.g. Winter et al. 2009, Adger et al. 2016). In both our cases, voluntary programs such as access to chipping equipment were most supported where the outcomes had a dual purpose such as improving property aesthetics or saving money in addition to wildfire risk reduction. However, the success of incentives as an alternative to mandatory actions depends on funding to support these efforts, and it is unclear whether communities are able to sustain these approaches without external support. Fostering approaches that pair wildfire risk reduction with some benefit that would be of interest to a community and its residents is a leverage point for increasing collective action. Focus on these risk reduction approaches at the community level in both cases gives further credibility to risk reduction efforts that emerge from bottom-up, grassroots efforts.

Changing demographic characteristics, particularly a growth in part-time residents, heightened support for regulatory approaches in Timber Lakes. The opportunity to enforce more consistent mitigation efforts as a substitute for inconsistent voluntary mitigation made

regulatory approaches appealing. Frequent turn-over and a decline in full time residents have been identified as barriers to collective action in a vast number of WUI communities across the west, particularly those that attract amenity migrants and offer access to public lands or recreation like Timber Lakes (Stedman 2006; McCaffrey et al. 2011). In communities with some formalized regulating body like a POA, regulations on future developments may offer one approach to fostering risk-mitigation behaviors among incoming residents. Future research efforts to understand the influence of local context on support for voluntary or regulatory approaches to fire may benefit from experimental evaluation of how targeted approaches resonate or are responded to by subsets within geographic area are received by that group, and the impact these various approaches or messages might have on willingness to participate in collective action at the community level. Community evolution across the U.S. will likely require continual revision and adaptation of approaches to mitigation efforts that meet the needs and challenges of these changing populations. The research presented here contributes to this by outlining the routes rural unincorporated communities may take to address wildfire in the absence of government collaboration. Our results suggest that one predominant challenge to this process remains the balancing of considerations used by both long-term and newer residents, and negotiating between the differing attitudes they may have towards voluntary or mandatory wildfire risk reduction.

Discussion in both communities frequently focused on prioritizing the need for education over regulatory approaches, which community members wanted to see introduced as a way to raise awareness of fire risk primarily among new or part-time homeowners. Demonstration properties in each community were presented as one possible platform for melding education with opportunities to understand how vegetation management affected

community identity and place attachment. It also allowed residents the opportunity to consider and educate themselves about the issue at their own pace, without requiring formal participation, and without having such learning occur as a one-way transfer from government officials. Providing outlets for residents to determine whether mitigation actions were impactful was a core need among residents in both populations who wanted to protect their vegetation for aesthetic reasons. However, a vast body of literature finds that education does not necessarily translate into action to address wildfire risk (e.g. Eriksen and Gill 2010; Hesseln 2018). These efforts and the research presented here indicate that there is an increasing disconnect between opposition for regulatory approaches and the ability of education to create sustained and effective change at the community level. Moving away from a dependence on the perceived success of education as a motivator for voluntary mitigation actions requires the development of approaches that specifically address inaction or inconsistent participation while still promoting leadership and control at the local level.

Our results indicate that a combination of local interest in grassroots efforts, paired with a distrust of county, state or federal governments produced divergent preferences for local leadership on wildfire risk reduction in both communities. Timber Lakes backed ideas regarding regulatory and voluntary efforts that would be overseen by their POA, while Story residents sought to support leadership through the local volunteer fire department and its affiliated local champions. Much of this support was tied to positive experiences with government funding or resources that facilitated autonomous and self-organized benefit to each community—for example, access to thistle-spraying resources and chipping equipment. These programs allowed residents to benefit from government oversight without a perception of losing local control over decision-making about private property management.

Absence of willingness or ability to pay for mitigation could leave residents in both communities reliant on government funding to reduce their risk. However, the continuity of such projects or funding may be uncertain, which could leave communities potentially vulnerable if these finite financial resources were no longer available. This dependence on external support for risk reduction has been identified in other studies as the 'disaster mitigation paradox' or guardianship model, where efforts to address risk more broadly through community-level efforts such as fuel breaks remove responsibility for mitigation at the individual parcel level (Steelman 2008). There is a clear need to explore how communities can become more independent and sustainable in their efforts to reducing wildfire risk absent of outside assistance or grants, particularly willingness to pay for collective efforts that would create benefits at the community level. In Timber Lakes, many residents did not have the skillsets required to remove large trees close to their homes. In these instances, creating opportunities for developing practical skills or for partnering residents with others in their community who do have those skills may increase local capacity to reduce hazardous fuels.

6. Conclusion

This study advances existing understandings surrounding community adaptation to wildfire by highlighting the context-dependent nature of support for regulatory wildfire risk reduction in more rural and informal communities. Our results suggest that the interconnectivity of property-level residential adaptation, the structure of collaborative processes, and preferences for leadership or decision-making relationships among residents and organizations pursuing adaptation are a core driver of support or opposition for various voluntary and regulatory approaches to wildfire risk reduction. The factors influencing each

of these three considerations are influenced by existing local contexts (Paveglio et al. 2012, 2015), and highlight the potential for variation in preferences and needs across WUI communities. Options that preserve or strengthen community identity and allow for community oversight in decision-making may be more attractive to residents when considering whether to support or adopt a wildfire risk reduction approach. Specifically, residents seek to understand whether management actions will affect their values or address genuine needs in their community when determining the place-specific path necessary for wildfire risk reduction. Changing social dynamics in WUI communities may create windows of opportunity where regulatory approaches may be more viable than at other moments in time, but it can also create conditions to support alternatives to regulation that can strengthen local capacity to adapt. Engaging communities in decision-making and design of approaches to wildfire risk reduction, and partnering with trusted agencies or organizations offers a clear path forward to produce sustained collective action at the local level, but the exact form of those pathway components may differ across locales.

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