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Investigating Wildfire as a Catalyst for Community-Level Resilience

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INVESTIGATING WILDFIRE AS A CATALYST FOR COMMUNITY-LEVEL RESILIENCE

By

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Sincerely,

Lily Jane Clarke

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Thesis Abstract

Wildfire is increasingly entering the global consciousness as severe events in California, Australia, and Greece elicit intense emotional response while exposing the consequences of a changing climate. In concert with uncertainties around climate change, policymakers, scientists, and activists call for supporting the resilience of social and ecological systems. Yet resilience as a concept is not monolithic. Resilience speaks to maintaining core structures and functions, but also adapting and transforming them so they may coexist with current and future disturbances. Questions remain over who decides which core structures and functions of a particular system are most valued, whether they should be adapted or transformed, and who benefits from system interventions. In an age where knowledge is situated by media outlets, policies, and worldviews, resilience is a goal that can be easily usurped by those who benefit from extant system structures and functions. Therefore, from a social justice framework, if resilience goals are to enhance equity and well-being, grassroots efforts must engage in creation and pursuance. In the case of wildfire, this includes mobilizing the communities which have and potentially will be exposed to wildfire events. Communities, a compilation of social and institutional structures, will need to consider and work within, or seek to modify, institutional barriers to pursue their resilience goals. Because wildfire does not recognize boundaries, local resilience goals will need to be situated in the fire susceptibility of the landscape in which communities are built. Overall, if resilience is to be a productive goal for communities to pursue, communities themselves must comprehensively articulate the values they wish to be resilient, identify the disturbances or perturbations those values need to be resilient to, select the form of resilience they wish to support, and ensure that resilience benefits are distributed equitably and fairly.

Perceptions of community-level outcomes following wildfire events may indicate how successful community resilience building efforts are in articulating and pursuing resilience goals. Here, I

conceptualize community resilience as a process that allows communities to thrive during and between disturbance events such as wildfire. Utilizing this framework, perceptions of positive outcomes following a wildfire event indicate resilience efforts are achieving their aim. To study these dynamics with my thesis research, I utilized concepts from community resilience theory and assessed how individual perceptions of community-level outcomes following wildfire events were associated with community-level resilience building efforts. I acknowledge the inherent limitations to employing individual perceptions in the study of community-level phenomena, as perceptions may not reflect actions taken to support community-level resilience and are subject to the conceptualization and definitions that each may ascribe their 'community.' However, by adopting individual perceptions to study community-level resilience, I sought to better understand which theorized community resilience efforts were viewed in a positive light by individuals affected by wildfire, thus shedding light on important individual and community-level dynamics related to wildfire and wildfire response.

To pursue my research questions, I analyzed survey responses and facilitated group discussion dialogue, both conducted in the Bitterroot Valley, Montana and in the Methow Valley, Washington in the United States of America. In Chapter One, I review the literature on community resilience to wildfire, concluding with pertinent research questions guiding the following chapters. In Chapter Two, I built a multiple linear regression model to assess which community-level characteristics and wildfire impact factors were associated with individual responses to the statement "Wildfire events made my community stronger," a metric of perceptions of community-level outcomes. Model results suggested that perceptions of strong leadership and community engagement, a sense of feeling at home in the community, effective communication with wildfire managers and access to wildfire information, adequate protection from wildfire, and contextual community and wildfire factors were associated with people perceiving positive community-level outcomes following wildfire. Interestingly, negative impacts caused by wildfire, an understanding of wildfire risk, loss of cellphone connection, internet connection,

and television service, a sense of community, gender, and age fell out of the final model, suggesting they did not affect perceptions of community-level outcomes, at least in these instances. Although these findings did not address the question of who benefits from community resilience building efforts, nor whom the survey respondents viewed as their community, they do suggest that certain community-level processes in the resilience literature and certain wildfire impact factors are associated with perceptions of positive community-level outcomes whereas others are not. To my knowledge, this is the first research study that empirically evaluates whether factors theorized to support community resilience are in fact associated with perceptions of positive community-level outcomes. Thus, this research contributes to resilience literature by identifying which social factors are associated with community resilience as a process, and supports managers, political figures, and community members investing in select social factors that support community-level resilience.

In Chapter Three, I seek a more nuanced understanding of how perceptions of community-level outcomes may relate to community-level resilience through an analysis of notes and records from facilitated group discussions in the same two valleys in which the survey was conducted. From these discussions I found that individual perceptions of community-level outcomes following wildfire exposure were influenced by people in the valleys sharing resources during wildfire events, seeing wildfire agencies improve coordination and cooperation between and during wildfire events to support fuel mitigation and wildfire response measures, and increasing social investment in wildfire preparedness in the valleys. Taken together, my research suggests there is a connection between residents of the valleys perceiving positive community-level outcomes and residents of the valleys investing in measures that support community-level resilience to wildfire. These findings suggest that resilience literature can utilize perceptions of positive community-level outcomes as an indicator of community resilience, when appropriate caution is exercised. Additionally, these findings encourage managers, researchers, and politicians to further investigate why perceptions of community-level outcomes are positive or negative,

as it may reveal mechanisms behind the productivity (or failure) of community resilience building efforts. The Thesis Conclusion further summarizes these findings and calls for more empirical evidence on which factors are associated with perceptions of community-level outcomes, and what that may mean for community-level resilience.

Chapter 1

Community Resilience to Wildfire: A Call to Study Perceptions of Community-Level Outcomes

Communities, wildfire managers, and scientists are increasingly challenged by the societal and ecological effects of wildfire events. Wildfire frequency and extent is increasing in the Western United States due to climate change (Abatzoglou & Williams, 2016) and the United States' sociopolitical expectations of wildfire suppression (Calkin, Thompson, & Finney, 2015). Wildfire suppression has increased fuel loads and fuel connectivity in low to mid-elevation forests with historically short-interval fire regimes, and shifted high-elevation forest age structures with historically long-interval fire regimes (Keane et al., 2002). Wild and prescribed fires can decrease fuel loads and connectivity, which can lessen the ecological and social consequences of wildfire events (e.g., Wade, 1989; Peterson & Reich, 2001; Fernandes & Botehlo, 2003; Stephens et al., 2009; Price, 2012; North, Collins, & Stephens, 2012). Although managerial communities in the United States increasingly recognize fire utility, immediate threats to human livelihoods, lives, and homes take precedence. Further, even though not all fires threaten humans, wildfire agency incentive structures burden the blame of fire repercussions on individual wildfire managers (Ryan, Knapp, & Varner, 2013), increasing the motivation to suppress wildfires and decreasing the motivation to prescribe fire. Social acceptability of wildfire has largely changed how wildfire interacts with ecological systems, which in turn influences how wildfire affects human communities in the Western United States.

Human use and suppression of wildfire have impacted how ecosystems respond to wildfire (Guyette, Muzika, & Dey, 2002; Bowman et al., 2011; Archibald et al., 2013; Roos et al., 2014). The evolution of fire-adapted landscapes was highly influenced by Native American use of fire for cultural and sustenance needs before European control of the North American landscape (e.g., Anderson 2006, p. 419). Upon European expansion into North American landscapes, wildfire became a nuisance in how

it reduced timber harvests and threatened permanent settlement structures. The mentality around and management of wildfire in the United States was highly influenced by the fires of 1910, which burned three million acres in the Western United States and killed 87 people. Consequentially, the fires of 1910 reframed wildfire as a threat to prosperity and development in national consciousness (e.g., Schullery, 1989). Since the fires of 1910, sociopolitical expectation of wildfire suppression in the United States has materialized and evolved in forms of rules and technologies. For example, in 1935 the U.S. Forest Service established a policy that all wildfires must be put out before 10 A.M. This policy is now largely released from political expectations, yet the dominant paradigm that wildfires need to be suppressed prevails. Technologies such as fire retardant and machinery have extended fire suppression capacity, causing unprecedented fuel loads and continuous fuel connections between surface fuels, between crown fuels, and from the surface to the crown of the canopy, increasing the intensity and extent of crown fires (Stephens et al., 2009). Taken together, social expectations create a positive feedback loop between wildfire suppression and fuel buildup which enhance wildfire spatial and temporal extent (Marlon et al., 2012; Calkin, Thompson, & Finney, 2015). Humans are also largely responsible for increases in ignition sources (Balch et al., 2017) and the extension of wildfire seasons due to climate change (Abatzoglou & Williams, 2016).

Increased occurrence and spatial extent of wildfire, coupled with humans continuing to build into fire-susceptible landscapes (Dombeck, Williams, & Wood, 2004), increases the number of human communities exposed to wildfire. Wildfire exposure impacts the well-being of human communities. Wildfires have been shown to increase cases of asthma (Bowman & Johnston, 2005) and other respiratory illnesses, threaten lives, livelihood, and property, which may cause mental trauma, and effect cash flow into local economies. Wildfire will continue to affect human communities, and the ways in which human communities affect and are affected by wildfire make wildfire a social-ecological issue (e.g., Dombeck, Williams, & Wood, 2004).

Social-ecological resilience to wildfire is increasingly articulated as a goal by communities, policy-makers, and scientists (e.g., Folke et al., 2010; Moritz et al., 2014; Smith et al., 2016; Schoennagel et al., 2017; McWethy et al., 2019). Social-ecological resilience is the concept of maintaining core structures and functions within both the social and ecological components of a system while adapting to new needs and challenges. Social-ecological resilience as a goal has materialized into programs and political initiatives in the Western United States. For instance, the Healthy Forests Restoration Act passed in 2003 to support forest fuel reduction programs and ecological biodiversity, enhance the value of forest products, and reduce the risk of community exposure to wildfire (Act, 2003). In order to reduce community risk to wildfire, the Healthy Forests Restoration Act promoted Community Wildfire Protection Plans. Community Wildfire Protection Plans "help a community clarify and refine its priorities for the protection of life, property, and critical infrastructure in the wildland–urban interface" (CWPP, 2004, p. 2) and therefore aim to boost community participation in resilience planning processes. In addition, the National Cohesive Wildland Fire Strategy further promotes three tenets of wildfire resilience strategies: landscape restoration through fuel mitigation, fire-adapted communities through education and assistance in better preparing properties in the event of a wildfire, and increased wildfire response capacity (USDOI & USDA, 2014). All in all, the Healthy Forests Restoration Act, Community Wildfire Protection Plans, and the National Cohesive Wildland Fire Strategy articulate that social cohesion and participation are required for community resilience and the social-ecological system of which they are a part.

Resilience is not a single definition but rather a socially and institutionally situated process (Norris et al., 2008; Kulig et al., 2013; Schumann III et al., 2020), dynamic in that communities tailor their resilience goals by envisioning current and future needs. Four tenets of resilience help address the contextual characteristics of community resilience. First, resilience 'of what' considers which values individuals, communities, and societies prioritize to be resilient (Carpenter et al., 2001). Second,

resilience ‘to what’ determines what communities are trying to be resilient to. In this thesis, communities are trying to be resilient to perceived negative consequences of wildfire events. Third, what kind of resilience communities wish to develop is conceptualized overall and per value. Three overarching types of resilience include basic, adaptive, and transformative resilience (Folke et al., 2010; Schoennagel et al., 2017; McWethy et al., 2019). Basic resilience is resistive in that a value with basic resilience can bounce back to being how it was before a wildfire event, thereby maintaining pre-wildfire core structures and functions. Adaptive resilience measures are when communities adapt core structures and functions so that they may better live with disturbance events and regimes, which are patterns of disturbance events. Transformative resilience measures describe communities intentionally transforming their fundamental core structures and functions to be able to coexist with future wildfire events and regimes. Fourth, resilience ‘for whom’ considers which voices are being heard and are benefitting from resilience conferring measures and which ones are being left out (Cote & Nightingale, 2012; Cretney, 2014), as some community members may benefit from resilience measures at the expense of others. For example, development companies may claim that they need to continue building in fire susceptible areas in order to gain profit and provide local jobs at the expense of making more community residences at risk of wildfire exposure. Resilience to wildfire is therefore situated by which values communities wish to be resilient, what communities are trying to be resilient to, how resistant, adaptive, or transformative individuals, communities, and societies may want to be to certain hypothesized or imminent changes from wildfire events, and who is able to benefit from resilience conferring measures.

Communities, nested within social-ecological systems, are part of a panarchy. A panarchy conceptualizes systems of different spatial and temporal scales as nested within and affected by one another to different degrees (Holling & Gunderson, 2002). The adaptive renewal cycle, often applied to social-ecological resilience theory, considers how systems go through phases of reorganization, release,

conservation, and growth. The adaptive renewal cycle thus exemplifies how the vulnerability and resilience of systems change over time as systems are exposed to disturbances (Holling & Gunderson, 2002). If a disturbance is severe enough, it may throw a system out of its core adaptive renewal cycle and transform a system's fundamental structures and functions. Yet the adaptive renewal cycle, although it shows resilience as a continuous process, has limited use when focusing on the resilience of social systems. The adaptive renewal cycle does not consider the capacity for communities to adapt within institutional boundaries, therefore ignoring the concept of differential adaptive capacities. For this reason, conceptualizing adaptative capacities within an adaptation envelope, which considers how agency is constrained by "interacting local and extra-local cultural, economic, political, and institutional processes" (Wyborn et al., 2014, p. 3), is more productive. Although resilience is a continuous process, it cannot be presumed that community resilience maintains the same categorical patterns when context is considered.

Community resilience to wildfire is contextualized by community priorities and their sociopolitical and ecological histories. Communities are more than an amalgamation of the individuals living within a defined geographical space. Communities are the social and environmental structures that people are governed by and interact with, and are the "process of collective action expressing the solidarity of the local population" (Wilkinson, 1991). Communities are also unbalanced in which interest groups and individuals are powerful enough to craft resilience measures that benefit them (Cretney, 2014). Yet resilience literature often utilizes perspectives from individual community members to develop indicators of community resilience, rather than studying the social and institutional structures that influence perspectives (e.g., Absher, Vaske, & Lyon, 2013; Kulig et al., 2013; Kulig & Botey, 2016; Linberg & Swearingen, 2020). Because empirical research on community resilience is often grounded in individual perspectives, strengths and weaknesses are considered. For weaknesses, by measuring individual perspectives, we lack an understanding of how social and political institutions may prevent

opinions or desires from materializing or even being discussed (Cretney, 2014). For example, funding may prevent agencies from consistently participating in fuel reduction treatments, and the market may make fire-resistant building materials financially inaccessible. Social and political structures govern the individuals' and communities' ability to make the changes they deem desirable and to foster resilience. Without considering social and institutional barriers, community resilience research overestimates the ability of research participants to make their communities more resilient to wildfire in the ways they deem desirable (e.g., Wyborn et al., 2014). For strengths, by utilizing individual perspectives to assess community resilience, Kulig and Botey (2016) highlighted that communities mediate an individual's experience. Individual perspectives give researchers a sense of how communities mediate wildfire experiences for individual community members (Cortner et al., 2003) and which resilience conferring measures individuals see as creating positive community-level outcomes. Community resilience is influenced by individuals and mediated by social and institutional structures. Therefore, which community members and which communities' data are gathered from will influence how researchers conceptualize resilience, and whom resilience measures will truly benefit.

Community resilience is theorized as a set of adaptive capacities, in which the capacities are "robust, redundant, or rapid to buffer or counteract the effects of the stressors such that a return to functioning, adapted to the altered environment, occurs" (Norris et al., 2008, p. 130). Community resilience literature considers community characteristics such as strong leadership, community engagement (Kulig et al., 2013), economic diversity, robust information networks, and trust (Norris et al., 2008) as adaptive capacities that will allow humans to respond and adapt to changes in their physical and social environments. Overarching categories of adaptive capacities include "capitals" that humans have such as social capital, which considers how individual and institutional social capacities are made up of social networks, trust, and community involvement woven together (Dubos, 2017). Because communities are made up of individual and institutional capacity, community resilience theory considers

how these capacities interact to change or stabilize social and structural processes in response to changing circumstances.

I frame community resilience as the processes that enable communities to respond to changes in wildfire dynamics and in doing so thrive (e.g., Brown & Kulig 1996). I therefore see the theoretical concept and practical application of resilience as enhancing the well-being of communities and community equity. Within this framing, community resilience is overall more adaptive than resistant, though communities may still invest in basic resilience for certain structures and functions. Although it is uncertain whether wildfires will increase in severity, the increases in wildfire ignition and extent (Abatzoglou & Williams, 2016) indicate that human communities in the Western United States will be increasingly exposed to wildfire events (Moritz et al., 2014; Schoennagel et al, 2017). For communities to thrive during and between wildfire events, certain social processes that encourage productive and equitable investments in resilience conferring measures may be required.

A “window of opportunity” for political and social change may open between wildfire events (Mockrin, Fishler, & Stewart, 2018). Mockrin, Fishler, and Stewart (2018) found that “windows of opportunity” may become available when a large wildfire is novel, there is strong community and agency leadership, and there is already robust agency capacity. Yet there is an abundance of examples in the literature where communities felt heightened social bonds as a result of collectively experiencing a wildfire event (e.g., Cox & Perry, 2011; Cortner et al., 2013; Kulig & Botey, 2016), and it is unclear whether heightened social bonds contribute to communities taking advantage of “windows of opportunity.” My thesis seeks to explore what factors are associated with the perception of strengthened social bonds following wildfire events and how that perception is connected to community resilience building efforts.

Perceptions of increased social bonds indicate that individual community members perceive positive community-level outcomes. This is demonstrated by the language community members use. For example, community members in other research papers have utilized terms such as “stronger” or “better” to describe their communities following wildfire exposure (e.g., Cox & Perry, 2011; Kulig & Botey, 2016). Perceptions of positive community-level outcomes following wildfire events may indicate that communities are thriving during and between wildfire events, and therefore community-level resilience building efforts have been effective.

Investigating perceptions of community outcomes may support theoretical and practical understanding of community resilience to wildfire. Understanding the factors that contribute to positive perceptions of community outcomes may serve community resilience literature by identifying which factors allow individuals to perceive their community as thriving during and between disturbances. In addition, managers who seek to support social-ecological resilience to wildfire in the way of social acceptance of prescribed fires, community investment in Firewise certification programs, and community engagement in Community Wildfire Protection Plans may benefit from knowing which community characteristics are most worth investing in. Although individual perceptions of positive outcomes do not fully encompass efforts in and results of community-level resilience as a process, they do indicate whether community-level resilience building efforts enable community members to feel as though their community is thriving as a result of those efforts. This does not necessarily extend to a concrete definition of community or an objective measure of community resilience, but further contributes to understanding community-level resilience as a complex and dynamic process.

My research questions are: 1) Which factors are associated with perceptions of community-level outcomes following wildfire; and 2) are individual perceptions of community-level outcomes connected with community-level resilience building efforts? I will examine my first question by quantitatively assessing which community-level resilience and wildfire impact factors may be associated with

perceptions of community-level outcomes. I will do so in Chapter Two by utilizing survey data collected from residents living in communities in the Bitterroot (MT) and Methow (WA) Valleys. Some of the survey questions were adapted from resilience scales in Kulig et al. (2013) and Absher, Vaske, and Lyon (2013) and other survey questions were crafted by the Joint Fire Science Project team I have had the honor to be a part of: Social-Ecological Resilience in Fire-Prone Landscapes, JFSP 16-3-01-24. I will create independent composite variables utilizing survey question responses and then generate a multiple linear regression model to identify which composite variables are associated with responses to the dependent variable "Wildfire events made my community stronger", a metric of perception of community-level outcomes. I will address my second question by qualitatively assessing what community-level actions may have led valley residents to perceiving positive outcomes in their valleys following wildfire events. I will do so in Chapter Three by analyzing facilitated group discussions in the same two valleys in which the surveys were released. Specifically, I will discuss actions that contributed to valley residents perceiving positive outcomes in their valley following wildfire events. Overall, this thesis will explore how perceptions of community-level outcomes following wildfire events may be associated with community-level resilience building efforts. The Thesis Conclusion will summarize findings from Chapter Two and Three and speculate on what my research results may mean for community resilience theory and practical efforts to support community-level resilience to wildfire.

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Chapter 2

Investigating which Community Resilience and Wildfire Impact Factors are Associated with Perceptions of Positive Community-Level Outcomes

[TO BE SUBMITTED TO *SOCIETY & NATURAL RESOURCES* FOR REFEREED PUBLICATION]

Keywords: Community, outcomes, resilience, wildfire, "window of opportunity"

Abstract

Community resilience is increasingly discussed in academic literature, policy initiatives, and project goals in response to climate change. Although authors acknowledge that resilience must be framed as flexibility or adaptability, resilience is still often conceptualized as resisting changes caused by disturbances. Yet disturbance forces may be an integral part of communities shifting or transforming practices to maintain structures and functions, often serving to make communities stronger. Specifically, threatening events such as wildfire may catalyze communities into investing in community resilience building efforts. Here, we investigate which factors supported perceptions of community-level outcomes following wildfire events by analyzing quantitative survey results from the Bitterroot (Montana) and Methow (Washington) Valleys, USA. Results suggest that community members perceiving positive community-level outcomes following wildfire events is associated with community members feeling well-informed throughout wildfire events, having a strong sense of community, community leadership, and community engagement, and feeling adequately protected. Additionally, unique community and wildfire characteristics played a key role in bolstering perceptions of positive outcomes while having wildfire impacts negatively affect health and well-being was not significantly related. Managers and community leaders may benefit from increased attention to these important variables when planning for community resilience to wildfire, as programs promoting physical structural integrity (such as

Firewise programs) may be less important than developing the community relationships necessary to boost all aspects of community resilience to wildfire.

Introduction

Social-ecological resilience to wildfire is increasingly articulated as a goal by academics, political entities, non-profit organizations, and wildfire management agencies (e.g., Paton & Tadim, 2012; Bone et al., 2016). As wildfire extent and frequency increases in the Western United States (Abatzoglou & Williams, 2016; Balch et al., 2017) and as human communities continue to build into flammable landscapes (Radeloff et al., 2018), measures aiming to confer resilience are challenged by the environmental and social context of the communities in concern. Resilience goals will be subject to community and agency priorities, ranging from returning a system to how it was pre-disturbance (i.e., 'bounces back') to creating measures that allow for adaptation or even transformation of a system (Folke et al., 2010; Schoennagel et al., 2017; McWethy et al., 2019). More research (e.g., Moritz et al., 2014; Schoennagel et al., 2017) and programs (e.g., Fire Adapted Communities and Community Wildfire Protection Plans) are encouraging communities to learn how to live with wildfire rather than rely entirely on wildfire suppression tactics.

Although literature and programs use words such as "flexible" and "adaptive," community resilience to wildfire is still generally conceptualized in a resistance framework where wildfire must be "fought." This framework only identifies possible negative outcomes of communities experiencing a wildfire event, without considering how experiencing a threatening event such as a wildfire can catalyze communities to strengthen their social fabric and the positive outcomes that may follow. Recent studies have shown that community members can perceive positive community-level outcomes after collectively experiencing a wildfire event, and that those positive outcomes may support communities in investing in long-term resilience strategies (e.g. Blatner et al., 2003; Cortner et al., 2003; Cox & Perry,

2011). Here we investigate which factors are associated with individuals perceiving positive community-level outcomes following wildfire events.

Efforts to support community resilience to wildfire tend to focus on physical structural resilience to wildfire, exemplified in initiatives such as the Healthy Forests Restoration Act (Act, 2003) and programs that develop Community Wildfire Protection Plans or promote Fire Adapted Communities. Although preparing physical structures for wildfire exposure may make communities physically safer, there is less emphasis on social processes that may advance all aspects of resilience programs. For example, social cohesion between wildfire events may be the catalyst for communities investing in comprehensive resilience programs, which could boost efforts to prepare physical structures for wildfire. Because stakeholder engagement in programs cannot be assumed to result in social cohesion and can even enhance social disagreements (e.g., Walker & Hurley, 2004) and inequities, investing in social processes that boost community resilience is warranted. This leaves a question of which social processes support community resilience to wildfire.

Community resilience considers the well-being of individuals and their access to resources in concert with a community's ability to collectively solve problems (Chaskin, 2008). Community resilience is a dynamic process (Schumann III et al., 2019), and will look different depending on what communities prioritize for their resilience conferring efforts (e.g. Higuera et al., 2019) and what disturbance or perturbation they wish to be resilient to (Carpenter et al., 2001). Additionally, there are different forms of resilience communities may wish to invoke in their system or in specified priorities. Communities may wish to support basic resilience in their development plans, where they rebuild after a wildfire event to return their physical structures and daily lives to how they were before a wildfire event. Alternatively, communities may invest in adaptive measures that support resilience, such as legally requiring new buildings be built out of fireproof materials to enable development goals. Communities may even transform their communities to support resilience to wildfire, such as implementing zoning regulations

and consequentially changing their development course so that they may better live with wildfire (e.g., Folke et al., 2010; Schoennagel et al., 2017; McWethy et al., 2019). Additionally, whom the resilience conferring actions benefit will be influenced by community power structures and the historical, cultural, and political histories in which they are situated (Cote & Nightingale, 2012; Cretney, 2014; Higuera et al., 2019). Finally, the community's access to resources and the degree of the threat they experience will impact their resilience planning (Chaskin, 2008; Cutter et al., 2008; Schumann III et al., 2019).

Different models have been developed to assess community resilience and identify what factors support community resilience. Norris et al. (2008) emphasized that community resilience is a network of adaptive capacities, where the dynamics of the resources and the feedbacks created by their properties are considered beyond the representation of the resources themselves. Accordingly, the network of adaptive capacities will help determine a community's ability to collectively conserve the values they deem priorities (Norris et al., 2008; Folke et al., 2010). Factors that support community resilience and that can be considered part of the network of adaptive capacities include community members having access to information, a community's ability to collectively solve problems, and community members having a sense of connection to the community and landscape in which they reside. Access to information goes beyond receiving information to actually trusting the sources from which information is received (Longstaff, 2005; Norris et al., 2008). Trusting information sources supports community members believing that they are receiving accurate information and can collectively develop meaning (Alkon, 2004). Collectively identifying and resolving problems can indicate that community members feel they are empowered and can make the changes they deem necessary (Perkins et al., 2002; Norris e al., 2008; Kulig et al., 2013; Lindberg & Swearingen, 2020). This in turn is influenced by community members' sense of community, a conceptual category that assesses community member investment in giving the time and effort necessary to debate, make decisions, and proactively make changes (Norris et al., 2008; Absher, Vaske, and Lyon, 2013). These factors are often assessed by analyzing individual

perspectives of community characteristics and personal experiences (Norris et al., 2008; Kulig et al., 2013; Absher, Vaske, & Lyon, 2013; Kulig & Botey, 2016; Lindberg & Swearingen, 2020). Individual perspectives on community-level outcomes may reveal whether or not communities were resilient to the disturbances they experienced, community resilience being associated with more positive evaluations by individuals of their community following wildfire exposure.

There are social sentiments that can be detrimental to communities investing in resilience measures. During and between wildfire events, communities can experience a feeling of hopelessness and a disregard for any mitigation efforts (Winter & Fried, 2000; Arvai et al., 2006; Schulte & Miller, 2010; Fischer, 2011) as a result of normalizing hazards (Anderson, 1965; Burnside et al., 2007) or, conversely, bolster mitigation efforts as a result of a heightened awareness of wildfire risk (Martin et al., 2009; McGee et al., 2009; Carroll et al., 2011; Brenket-Smith et al., 2013). Additionally, post-disaster efforts can exacerbate pre-disaster social inequities (Pais & Elliott, 2008; Peacock et al., 2012). Between wildfire events, conflict can be developed or enhanced between community members and agencies (Cortner et al., 2003), there can be encouraged rebuilding in fire-prone areas (Mockrin et al., 2015), and there can be a focus on future wildfire suppression and emergency response tactics rather than long-term safety and recovery goals (Mockrin et al., 2015). To better enable integration of social and ecological resilience goals, communities and fire management agencies can co-create long-term management, safety, and development goals (Ryan & Hamin 2006; Smith & Wenger 2007; Cutter et al. 2008) to support their vision of a resilient landscape.

Individual perceptions of positive community-level outcomes following wildfire events may catalyze communities to identify resilience goals and engage in resilience-conferring actions. Resource sharing during and after a wildfire has been noted as being positively perceived by community members in resilience literature (Carroll et al. 2000; Cortner et al., 2003; Kumagai, 2001; Blatner et al., 2003), which social research has articulated as a sign of social capital (Granovetter, 1973; Bourdieu, 1984; Burt,

1992; Keuschnig & Wolbring, 2015). Heightened social capital may bolster community resilience efforts by giving community members the social support they may need to be able to take full advantage of a "window of opportunity" between wildfire events (e.g., Fleeger, 2008), catalyzing communities into making long-term development goals, accepting new wildfire mitigation policies, and being open to ecological and social change (Solecki & Michaels, 1994; Fleeger, 2008; Ryan & Hammin, 2000; Mockrin et al., 2015). Therefore strengthened social bonds, a metric of social capital, may support community resilience. Kulig and Botey (2016) found community members feeling their community had been strengthened by collectively experiencing wildfire events supported by a heightened sense of community and place attachment. Further research is needed to articulate what factors lead to perceptions of strengthened social bonds as a metric of positive community-level outcomes following a wildfire event.

To better understand what factors may lead to perceptions of positive community-level outcomes following wildfire events, I analyzed survey data from two fire-affected valleys to explore what factors led to perceptions of increased community strength following wildfire exposure. The survey data combined attributes of community resilience models with sociodemographic and wildfire impact factors. Although I utilize concepts from community resilience theory, I reference perceptions and processes at the community-level because survey respondents answered survey questions on personal perceptions of their community and neighborhoods. I do not claim to study the unit of community due to the number of towns in each valley involved in the study and due to not conducting a rigorous analysis on what valley residents may perceive as community. Here I consider community-level as the perceptions survey respondents have of their self-defined community and neighborhood. Survey respondents lived within specific census tracts of the Bitterroot Valley of Montana and the Methow Valley of Washington state that were exposed to disastrous wildfires in the last five years. I hypothesized positive perceptions of community-level outcomes following wildfire events are bolstered

by community resilience building efforts because individuals' beliefs regarding community outcomes vary based on perceptions of community cohesion, information sharing, and leadership while controlling for individual sociodemographic factors and personal impacts from wildfire.

Methods

Study Area

We (JFSP 16-3-01-24) collected data from residents of the Bitterroot Valley of MT and the Methow Valley of WA. The Bitterroot Valley study area in Montana included the towns of Lolo, Stevensville, Hamilton, Victor, and Sula, and the Methow Valley study area in Washington included the towns of Twisp, Winthrop, and Mazama. According to the United States Census Bureau (2018), the estimated population of people over age 18 is 20,237 in the Bitterroot Valley, and 18,659 in the Methow Valley. We chose these census tracts for their proximity to wildfires in the areas within five years prior to the survey (2014-2019). The Methow Valley experienced the Carlton Complex Fire in 2014 and the Twisp River Fire in 2015. The Twisp River Fire, one of the five fires of the Okanogan Complex Fire in 2015, burned almost 12,000 acres, caused the death of three wildland firefighters, and destroyed 120 homes. The Carlton Complex Fire, Washington State's largest wildfire at over 256,000 acres, led to two human deaths and 353 homes burned. The Bitterroot Valley experienced the Roaring Lion Fire in 2016 and the Lolo Peak Fire in 2017. The Roaring Lion Fire destroyed sixteen homes, caused one human death, and 500 residences were evacuated. One year later, the Lolo Peak Fire lead to the death of a hotshot wildland firefighter, over 3,000 evacuations, and several destroyed residences. We felt that these two valleys are similar in that they are relatively rural and experienced severe wildfires within five years prior to the survey, and will provide us with insights on how people living within fire-affected areas may be collectively responding to wildfire in the Western United States.

Data Collection

We drew an initial simple random sample of 3000 households, evenly split between the Bitterroot and Methow Valleys, using residential addresses purchased from Dynata Inc. (formerly Survey Sampling International). The surveys requested that the member of each household who was at least 18 years old and had the next birthday complete the questionnaire to achieve 'resident' as the unit of analysis rather than the household (Dillman, Smyth, & Christian, 2014). Residential addresses fell within census tracts 15 (Missoula County) and 1, 2.01, 3, 4.01, and 5 (Ravalli County) in Montana, and census tracts 9705, 9706, 9707, 9708, 9709, and 9710 in Okanogan County, Washington (see Figure 1).

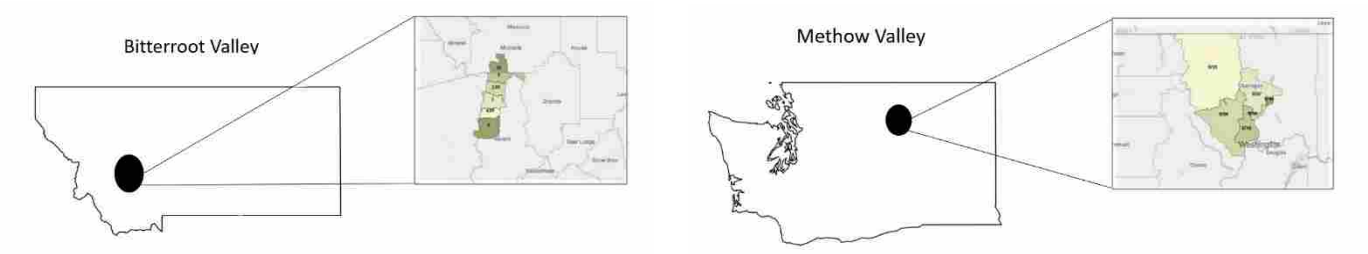

Figure 1. Maps of studied census tracts in Montana and Washington, respectively.

We administered the survey using a Tailored Design Method (Dillman, Smyth, & Christian, 2014), including an introductory letter with a unique internet link provided for survey participation and a follow-up letter thanking respondents and reminding nonrespondents of the unique internet link. We then mailed remaining nonrespondents an 8.5" x 11" questionnaire packet including both the unique internet link and a hardcopy of the questionnaire with pre-paid postage return envelopes, followed by one more identical packet if no one at the mailing address had responded. An indication of whether respondents perceived positive community-level outcomes following wildfire events was asked with an item asking respondents to agree or disagree with the statement "Wildfire events made my community stronger." The University of Montana Institutional Review Board approved the survey methods and questions on October 18th, 2018. The University of Montana's Bureau of Business and Economic Research (BBER) administered the survey from November 3rd, 2018 through January 8th, 2019.

Independent Variables

We surveyed residents' perspectives of their communities without investigating or defining who community members perceived their community to be, as well as topics that enquired on how well individual residents were informed of wildfire risks, whether they frequently lost access to internet, telephone, or television communication during wildfire events, how wildfire impacted them, and lastly sociodemographic questions. Some of these survey questions were adapted from community resilience scales (e.g., Norris et al., 2008; Kulig et al., 2013; Absher, Vaske, & Lyon, 2013). Other survey questions were written by the authors to investigate perceptions of community-level characteristics and how wildfire events impacted individual residents. The full questionnaire can be seen in Appendix A.

We conducted exploratory factor analysis with Varimax rotation on theoretical categories in the survey. Two of the scales on which we conducted exploratory factor analyses were previously established, the "Index of Perceived Resilience" (IPCR) (Kulig et al., 2013) and the "Sense of Community" scale (Absher, Vaske, & Lyon, 2013). We kept items in the IPCR as one factor to reflect the decision of Kulig et al. (2013). The items in IPCR are intended to measure individual perspectives of community engagement, leadership, and connections to the landscape. We extracted the "Sense of Community" scale, which operationalized the dynamics behind feeling a sense of community as described by McMillan and Chavis (1986), from a larger survey developed by Absher, Vaske, and Lyon (2013). Absher, Vaske, and Lyon (2013) developed their survey to better understand what encouraged and prevented people living within fire-prone landscapes to Firewise their properties.

We wrote the items that fall under the "Information and Communication" category of variables to address the conceptual category created by Norris et al. (2008) and the importance of trust and of feeling informed during wildfire events (Stidham et al., 2011). We also developed a category of "Impact" to address the degree of wildfire impacts on the survey respondent's well-being and livelihood, as the

degree to which the wildfire impacted the individual will likely affect their perceptions of the wildfire events they experienced. Finally, we included sociodemographic factors of age, gender, and state in our preliminary model, as these variables are often considered to account for potentially influential distinctions in the population (Cutter, 2008; Palaiologou et al., 2018)**.**

We extracted components with Eigenvalues of more than 1.0, and utilized reliability analysis tests to evaluate how consistent responses were for each composite variable. We then summed and calculated the mean for items within each composite variable to create the mean of the composite variable. All but three survey responses were on a 1 to 5 Likert scale: (1) Strongly disagree, (2) Somewhat disagree, (3) Neither agree nor disagree, (4) Somewhat agree, (5) Strongly agree. Three questions on internet, telephone, and television coverage during wildfire events in the last five years were on a 1 to 3 scale: (1) coverage was never lost, (2) lost one time, (3) lost more than once and were reverse coded. We reverse coded other questions that were stated in a negative manner (i.e. “The changes in my community are positive” versus “The changes in my community are negative”). Any “Not Applicable” item responses per composite variable were coded as missing data and removed from the analysis. We utilized IBM SPSS Statistics Version 25 (2017) and R version 3.5.3 for model analyses.

Model Selection

Parametric tests versus nonparametric tests differ in precision but do not result in differences in levels of significance when utilizing results from Likert scales (Mircioiu & Atkinson, 2017). For this reason we followed suit with the field in utilizing parametric linear regression analyses to test how well our independent variables predict responses to our “stronger” dependent variable. We conducted backward elimination of the statistical test Akaike Information Criteria (AIC) to determine the best possible linear regression model (Akaike 1987).

Results

Survey Response

Of the 3,000 surveys we administered, 771 people responded (452 were Washington residents, 319 were Montana residents) for a 25.7% response rate. Composite variables included in the model had a nonresponse rate that ranged from 0.021% ("Home") to 8.17% ("Network" and the dependent variable "Stronger" each had this response rate). Responses were assessed as missing at random to the degree that all original items were kept in the model. Table 1 shows the sample size per variable. Income was not included as a factor due to there being a 21.7% nonresponse rate and due to the census not reporting more information than median income per county. Twenty-nine missing ages of the 771 total respondents in the "Wildfire in the West" survey dataset were imputed. Ages were imputed utilizing variables related to age generated from Dynata, Inc. including the age of the first household resident, the age of the second household resident, the length of residence at the current address, and the estimated number of children in the household via the hot deck imputation method (Kim & Fuller, 2010; Washington, Andridge & Little, 2010). All survey responses from the Methow and Bitterroot Valleys were combined to make a total of 585 respondents assessed in the model.

Exploratory factor analysis

Kaiser-Meyer-Olkin measures for the component categories "Index of Perceived Resilience" (IPCR), "Sense of Community", "Information and Communication", and "Impact" were 0.88, 0.89, 0.86, and 0.78, respectively, indicating that variable items are suitable for factor analyses (Cerney & Kaiser, 1977). According to Bartlett's test for sphericity, we have strong evidence that our variable items would benefit from factor analyses: "IPCR" (χ^2= 4236.27, df=66, p<0.001), "Sense of Community" (χ^2= 2844.42, df=55, p<0.001), "Information and Communication" (χ^2= 3412.39, df=78, p<0.001), and "Impact" (χ^2= 824.17, df=21, p<0.001). Factor loadings of composite variables are shown in Table 1, along with means,

standard deviations, and Cronbach's alpha to assess reliability of the composites. Cronbach's unstandardized alphas ranged between 0.69 and 0.89, and because 0.8 is considered good and 0.7 acceptable (Vaske, 2008), all variables and their original item loadings were kept in the model (see Table 1).

Independent Variables

Items included in each composite variable can be seen in Table 1. Items in the "Index of Perceived Resilience (IPCR)" were kept as one factor to reflect the decision of Kulig et al. (2013), though the items factored into three composite variables both in their paper and in ours. The one-factor solution is the common variance which is 29.21% of the total variance; the single principal component would account for 40.64% of the total variance. The "Sense of Community" scale developed by Absher, Vaske, and Lyon (2013) factored into two variables in our dataset. The first factor in the "Sense of Community" scale was composed of all but three of the items within the "Sense of Community" scale. The second composite variable was a factor in Absher, Vaske, and Lyon (2013) and therefore we adopted their variable's name "Home". The two-factor solution is the common variance which is 57.15% of the total variance; the two principal components would account for 57.15% of the total variance. The items that fall under the "Information and Communication" category of variables were chosen to address the conceptual category created by Norris et al. (2008). Three composite variables fell under the category "Information and Communication". The first factor within the category of "Information and Communication" was titled "Effective Communication". The second composite variable was titled "Understanding of Risk". The third category was named "Coverage". The three-factor solution is the common variance which is 70.25% of the total variance; the three principal components would account for 70.25% of the total variance. A category of "Impact" was developed to address the degree of wildfire impacts on the survey respondent's well-being and livelihood. "Impact" factored into two composite variables. The first factor in "Impact" was named "Adequate Protection". The second factor was named

“Negative Impacts”. The two-factor solution is the common variance which is 62.18% of the total variance; the two principal components would account for 62.18% of the total variance.

Variables were not weighted because rather than elucidating an overall understanding of the population response, our study focused on the factors that may have led residents of the valleys to feeling that their community was “stronger”. We utilized means and standard deviations for variables because medians did not reveal noticeably different tendencies from the means in survey responses.

Independent Variables	**Mean**	**SD**	**Factor 1**	**Factor 2**	**Factor 3**
Index of Perceived Resilience (α = 0.78, N=752)	3.50	0.59			
Q8_h (My community has strong community leadership)	3.11	1.05	0.83		
Q8_g (Leaders in my community listen to residents)	3.22	1.05	0.81		
Q8_i (The changes in my community are positive)	3.25	0.93	0.81		
Q8_j (When a problem occurs, community members are able to deal with it)	3.46	0.86	0.73		
Q8_k (Residents of my community participate in community events)	3.73	0.89	0.44		
Q8_d (The people in my community are open to new ideas)	3.25	0.98	0.39		
Q8_f (There is a sense of pride among people in my community)	3.89	0.87	0.33		
Q8_a (The physical environment in my community negatively affects my health) *	3.54	1.32	0.32		
Q8_e (People who live in my community have similar values or ideas)	3.39	0.99	0.31		
Q8_b (People in my community help out one another)	4.21	0.85	0.06		
Q8_c (Residents in my community feel isolated from other parts of the state) *	3.0	1.19	-0.14		
Information & Communication					
Understanding of Risk (α = 0.79, N=739)	3.93	0.97			
I accurately understood the wildfire risk in my area before wildfires occurred (Q10_a)	4.02	1.19	0.04	0.75	0.02
I received adequate warning about wildfires (Q10_b)	3.97	1.14	0.34	0.8	0.12
I received adequate information about how to prepare for wildfires (Q10_c)	3.8	1.14	0.33	0.77	-0.02
Effective Communication (α = 0.89, N=756)	3.73	0.90			
Local news coverage was helpful (Q10_d)	3.74	1.17	0.48	0.40	0.20
My communication with fire managers made me feel cared for (Q10_e)	3.46	1.17	0.76	0.36	0.02
I was able to get the information I needed (Q10_f)	3.73	1.16	0.66	0.55	0.11
I knew how to get the help I needed (Q10_g)	3.77	1.14	0.56	0.54	0.05
Manned information booths were helpful sources of information (Q10_h)	3.69	1.21	0.86	0.10	0.10
Public information boards were helpful sources of information for wildfire events (Q10_i)	3.87	1.11	0.87	0.15	0.05
Public meetings were worthwhile (Q10_j)	3.62	1.12	0.79	0.19	-0.04
Coverage (α = 0.88, N=709)	2.42	0.75			
Did you ever lose your cellphone connection in a wildfire event in the past five years? (Q12) *	2.48	0.81	0.06	-0.03	0.87
Did you ever lose your internet connection in a wildfire event in the past five years? (Q13) *	2.35	0.85	0.04	0.08	0.93
Did you ever lose your television service in a wildfire event in the past five years? (Q14) *	2.50	0.79	0.06	0.10	0.87

Independent Variables	Mean	SD	Factor 1	Factor 2	Factor 3
Sense of Community					
Home (α = 0.88, N=758)	4.34	0.80			
I feel at home in this neighborhood (Q9_a)	4.37	0.88	0.24	0.87	
This community is a good place for me to live (Q9_b)	4.41	0.85	0.21	0.91	
My community is a special place to live (Q9_c)	4.25	0.93	0.28	0.79	
Sense of Community (α = 0.85, N=706)	3.53	0.73			
I recognize most of the people who live in my community (Q9_d)	3.51	1.14	0.61	0.31	
Most of my neighbors know me (Q9_e)	3.84	1.08	0.60	0.35	
People in my neighborhood generally get along with one another (Q9_f)	3.93	0.90	0.60	0.48	
People in my neighborhood share the same values (Q9_g)	3.39	0.97	0.67	0.27	
My neighbors and I want the same thing from this community (Q9_h)	3.44	1.45	0.59	0.02	
I feel a strong sense of community with my neighbors (Q9_i)	3.43	1.02	0.72	0.38	
If there is a problem in my neighborhood, people who live here get it solved	3.51	0.96	0.69	0.33	
I care about what my neighbors think about my actions (Q9_k)	3.66	1.08	0.59	0.24	
I have an influence over what this community is like (Q9_l)	3.11	1.04	0.67	0.11	
Impact					
Adequate Protection (α = 0.80, N=729)	4.06	0.93			
Despite any losses I am generally OK after a wildfire event (Q3_d)	3.87	1.20	0.66	0.18	
My pets and livestock were adequately protected (Q3_e)	4.17	1.05	0.84	-0.05	
My property was adequately protected (Q3_f)	4.00	1.19	0.85	-0.03	
Residents lives were adequately protected (Q3_g)	4.19	1.10	0.80	0.02	
Negative Impact (α = 0.69, N=752)	2.24	0.98			
Wildfire has negatively affected my life (Q3b) *	2.26	1.30	-0.09	0.77	
Wildfire has negatively impacted my recreation opportunities (Q3_i) *	2.32	1.24	0.08	0.77	
My health was negatively impacted by wildfires (Q3k) *	2.14	1.13	0.10	0.78	
Sociodemographic					
Gender (M=1, F=2) *(N=712)*	1.44	0.50			
State (MT=1, WA=2) *(N=771)*	1.42	0.49			
Dependent Variable					
Wildfire events made my community stronger[11] (Q3_c) *(N=710)*	3.58	1.02			

Table 1. Mean and standard deviation listed for each item and composite variable included in the preliminary model, and factor loadings and unstandardized Cronbach's alpha for each composite variable. * = Reverse Coded.

Final Linear Regression Model

Composite variables and sociodemographic variables in Table 1 were utilized as independent variables to predict response to the "stronger" dependent variable. Variance inflation factors were less than two for all independent variables in the model, indicating multicollinearity is not an issue. The residuals in our model did not appear to violate assumptions of a homogeneity of variance and normal distribution (see Figure 2). We proceeded with utilizing parametric regression analyses. The final model with the lowest AIC is presented in Table 2.

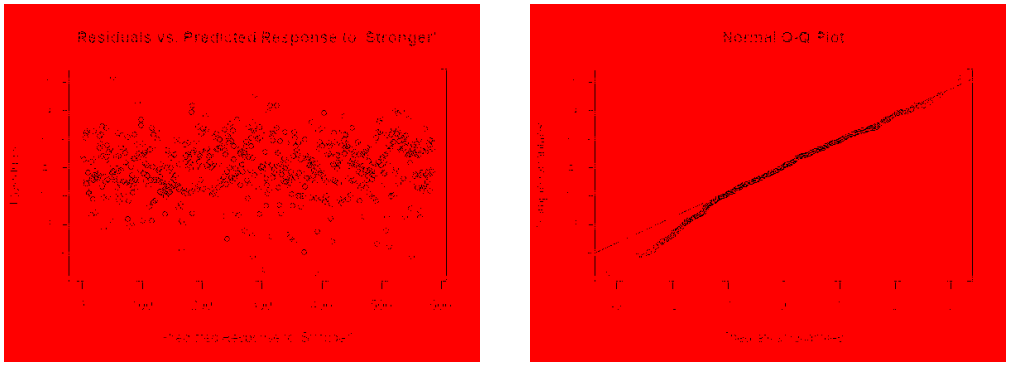

Figure 2. Residuals of the model did not appear to violate the homogeneity of variance or normal distribution assumptions.

Independent Variables	**Unstandardized β**	**Standardized β**	**SE**
Index of Perceived Resilience***	0.32	0.18	0.07
Effective Communication*	0.11	0.09	0.05
Home**	0.09	0.07	0.05
Adequate Protection***	0.33	0.30	0.04
State (MT=1, WA=2)***	0.52	0.25	0.07
Dependent Variable			
Wildfire events made my community stronger			

Table 2. Unstandardized betas, standardized betas, and standard error of our final linear regression model, alpha level = 0.10. *p<0.10, **p<0.05, ***p<0.001. Adjusted R^2 = 0.27, F-statistic = 43.96, degrees of freedom = 5 and 579, ***p.

Discussion

Community resilience building efforts are increasingly invested in by programs promoting Fire Adapted Communities and Community Wildfire Preparedness Plans. Yet these programs tend to focus on preparing physical structures for wildfire with less emphasis on what social factors may drive community members engaging in these efforts. Experiencing threatening and disastrous events such as wildfire can catalyze a community into strengthening their collaborative networks and demanding political maneuvers to reduce risk (Solecki & Michaels, 1994; Birkland, 1997; Cortner et al., 2003; Fleeger, 2008), but what factors support this still need to be explored. Community members perceiving positive outcomes following wildfire events may indicate this catalysis, as perceptions of positive community-level outcomes are likely related to residents feeling their communities are thriving during and between wildfire events. In my model, because community-level resilience factors were associated with perceived positive community-level outcomes, this suggests that a perception of positive community-level outcomes can indicate that productive community resilience building efforts are being undertaken at the community-level.

Our results indicate that community characteristics and wildfire impacts influence perceptions of community-level outcomes. Our model suggests that between and during wildfire events, strong leadership, community engagement, and a sense of feeling at home in the community support community members believing their community is stronger following wildfire. Additionally, our model suggests that factors supporting perceptions of community strength during wildfire events include adequate protection of lives and property during the event and, to a lesser extent, effective communication with fire managers and access to information about the wildfire. Finally, our model suggests that our “State” variable impacts perceptions of community strength. Overall, our model suggests that in order for residents to perceive positive community-level outcomes following wildfire events, social cohesion, place attachment, strong leadership, and community engagement need to be in place prior to the event (Kulig et al., 2013; Schumann III et al., 2019), residents need to feel well-

informed and their lives and livelihoods adequately protected during the event (Norris et al., 2008; Stidham et al., 2001), and that perceptions of community-level outcomes are affected by the historical, political, and social contexts of the areas (Cortner et al., 2003). These factors thereby warrant consideration and enhancement to boost community resilience building efforts.

Community reactions to wildfire events and wildfire preparedness efforts are strongly predicated by social relationships and process that occurred before and between wildfire events (Lachapelle & McCool, 2012; Prior & Erikson, 2013; Kulig & Botey, 2016). My findings build on community resilience literature by specifying social factors associated with positive perceptions of community-level outcomes which indicate community resilience. My findings also suggest that resilience is strongly associated with the ability of residents of wildfire-affected areas to be well-informed and have access to quality wildfire information (e.g., Goodman et al., 1998; Ganor & Ben-Lavy, 2003; Pfferbaum et al., 2005; Norris et al., 2008; Stidham et al., 2011). Sociopolitical contexts of communities will affect perceptions of wildfire and resilience building efforts (Cortner et al., 2003; Cox & Perry, 2011), and although the 'State' variable was controlled for in the model, residents of the Methow valley did perceive perceptions of positive outcomes to a higher degree than those in the Bitterroot. This may be because residents of the Methow valley were more invested in community-level resilience building efforts before or following wildfire events. This difference could also be due to variables that were not included in the model, such as to what degree residents were able to see the wildfire and therefore better understand to what extent it threatened them. It is interesting that our model suggests adequate protection of life, property, and animals as contributing to perceptions of community-level outcomes while negative impacts to health and well-being caused by wildfire do not affect these perceptions. This may mean that resilient communities are those that are well protected, even if there were negative impacts to the economy, health, and recreational opportunities.

The connection between an individual person's perception of community resilience and community resilience as a process is contested (Brown & Kulig, 1996; Kulig & Botey, 2016; Lindberg & Swearingen, 2020), as it does not account for the institutions that preside over an individual's experience and that affect individual agency. Communities, made up of individuals and their institutions, mediate the experience of a single individual and a fire event (Cortner et al., 2003). Our data are made up of reflections and perceptions of social and disaster processes, and although these can vary according to demographic and impact factors (McCaffrey et al., 2013), our data show that perceptions in these communities are less affected by personal factors (age, gender, negative impacts of wildfire) and more by processes that are strongly community mediated (social cohesion, communication, adequate protection, etc.). Although a better understanding of how individual perceptions of community resilience is connected with community resilience as a process is warranted (Berkes & Ross, 2013; Kulig & Botey, 2016), and although individual resilience does not necessarily translate to community resilience (Cutter et al., 2008; Cretney, 2014; Palaiologou et al., 2018), perceptions of adaptive capacities and community outcomes may indicate to what degree there is investment in community-level resilience to wildfire.

According to our model, factors that support community-level resilience (community engagement, access to information and communication, etc.) also support residents perceiving positive outcomes following wildfire events. This is an example of the challenge of differentiating between what confers resilience versus what is an indicator of resilience (Brown & Kulig, 1996; Lindberg & Swearingen, 2020). Therefore, our indicator of community-level outcomes is influenced by an individual living within an already considerably resilient community, one that has social cohesion (Norris et al., 2008; Kulig et al., 2013), attachment to place (Kulig et al., 2013), and resources and networks needed to adequately protect and inform its citizens during a wildfire event. Positive perceptions of community-level outcomes could serve as a surrogate for resilience (Carpenter, Westley, & Turner, 2005) if a community

is clearly defined because it indicates that a resilient community is one that engages in efforts that support resilience and has positive perceptions of outcomes from those efforts. If so, then enhancing social processes that effectively support efforts in and positive perceptions of community-level resilience to wildfire is warranted.

Conclusion

The resilience and desirability of a system is nested within its context, and will vary according to what system, community, or individual is being considered (Cretney, 2014; Palaiologou et al., 2018). Social-ecological systems thinking benefits resilience research and assessment (Berkes & Folke, 1998; Chapin et al., 2011; Berkes & Ross, 2013) by providing a more comprehensive view of how human development patterns, social values, political institutions, and ecological structures and function all influence the resilience of the system in which they reside (Walker et al., 2006; Berkes & Ross, 2013). I learned that community and wildfire characteristics influence perceptions of community-level outcomes following wildfire exposure. I utilized perceptions of heightened community strength following wildfire events as a metric of community-level outcomes. I was interested in perceptions of community-level outcomes because if communities are thriving during and between disturbances and are thereby resilient, residents will likely perceive positive outcomes, which may catalyze residents into strengthening their collaborative networks and identifying the social and ecological characteristics they deem desirable. These processes may then lead to community-level social and structural changes that are required for the kind of resilience residents wish to have to wildfire in the social-ecological system as a whole (Solecki & Michaels, 1994; Birkland, 1997; Cortner et al., 2003; Fleeger, 2008). This first attempt at measuring perceptions of community-level outcomes by answering positively to a single question on a survey (i.e., “Wildfire events made my community stronger”) likely does not fully speak to community-level outcomes or the possible resulting behaviors. More research is needed to identify better ways to measure perceptions of outcomes and the effectiveness and longevity of the behavior that may or may

not follow. Finally, perceptions of community-level outcomes may be predicated upon community-level characteristics that occurred between wildfire events and the unique experience of the wildfire itself (Cortner et al., 2003; Fleeger, 2008). Therefore, investing in the social processes that occur between wildfire events and that lead to positive perceptions of community-level outcomes following wildfire events is warranted to boost community-level resilience to wildfire.

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Chapter 3

Cookies, Quilts, and Hay: Connecting perceptions of positive community-level outcomes with community-level resilience to wildfire

Key Words: Community, resilience, resource-sharing, strength, wildfire

Abstract

Individuals perceiving their community as "stronger" following exposure to wildfire events has emerged in the literature. Yet it is unknown whether perceptions of community strength are a result of investment in community-level resilience to wildfire. We investigated the possible connection between perceptions of community strength and community-level resilience building efforts by hosting facilitated group discussions in two fire-affected valleys. During the facilitated group discussions, a more articulate picture of how wildfire events affected the residents of the valleys emerged along with a greater understanding of how resident perceptions are connected with community-level processes. Taken together, our findings indicate that efforts to support community-level resilience to wildfire, including residents sharing resources and in turn increasing social cohesion, wildfire agencies utilizing cross-agency resources to increase wildfire preparedness and response effectiveness, and residents creating community-level norms encouraging wildfire preparedness efforts, led to perceptions of increased community strength. Perceptions of community strength may therefore serve as an indicator of investment in community-level resilience to wildfire.

Introduction

Community resilience to wildfire has emerged as a central tenet of fuel mitigation and community capacity building programs in the Western United States. Despite uncertainty around

changing wildfire regimes in the Western United States (Turner, 2010), it remains certain that an increased number of human communities will be exposed to wildfire as wildfire seasons lengthen and wildfire extent (Abatzoglou & Williams, 2016) and ignition sources (Balch et al., 2017) increase in concert with continued development of wildfire-susceptible landscapes (Radeloff et al., 2018). Enhanced exposure to wildfire drives the question of how communities may not resist but rather coexist with wildfire (e.g., Moritz et al., 2014; Schoennagel et al., 2017), as over one-hundred years of wildfire suppression (Busenberg, 2004) and the effects of climate change (Abaztoglou & Williams, 2016) make it more challenging to manage wildfires (Schoennagel et al., 2017). Managing landscapes to reduce wildfire severity and extent is especially ineffective without social acceptance of mitigative tactics such as prescribed fire, and without social investment in preparing private property and community economies for wildfire season (Schoennagel et al., 2017). Programs and initiatives to support community resilience to wildfire in the United States include the Healthy Forests Restoration Act of 2003 (Act, 2003), which encouraged community involvement with fuel mitigation programs and created Community Wildfire Protection planning processes. In addition, the National Cohesive Strategy encourages Fire Adapted Communities through community engagement in measures that confer social and ecological resilience to wildfire (USDOI & USDA, 2014). These programs promote the understanding that each wildfire mitigation plan must be tailored to community expectations surrounding wildfire and to the ecology of the area.

Community resilience is conceptualized as a community's ability to maintain the structures and functions that the community in question deems desirable (Chaskin, 2008; Norris et al., 2008). Communities may consider different types of resilience desirable according to which social characteristics and structural components they prioritize for resilience measures. Communities may wish to retain the priority as it is (i.e., have it "bounce back" after a disturbance), or adapt or transform it so that it can be resilient to perceived negative impacts caused by a disturbance (Schoennagel et al.,

2017; McWethy et al., 2019). For example, a community may wish to operate farmers markets during a wildfire event as it always has, adapt it by moving it indoors to protect participants from smoke exposure, or transform it in that fuel mitigation is conducted around the community and farmers market area so that wildfire is not perceived as a threat. Social capital, the social networks and resources which result from and support social organization (Wellman & Frank, 2001), is considered to contribute to community resilience (Cox & Perry, 2011; Bihari & Ryan, 2012). Other social processes said to support community resilience include economic diversity, leadership, and access to information (Norris et al., 2008; Kulig et al., 2013; Absher, Vaske & Lyon, 2013; Kulig & Botey, 2016). Overall, I frame community resilience as a process that enables communities to thrive as they strive to coexist with wildfire (Brown & Kulig, 1996; Linberg & Swearingen, 2020).

Researchers often study community-level resilience by evaluating individual's perspectives of their communities via survey responses or interviews (e.g., Kulig et al., 2013; Absher, Vaske, & Lyon, 2013). Utilizing data from individuals to make inference on community-level processes is somewhat of a scale mismatch between data analyses and conclusions, which has generated questions regarding legitimacy (e.g., Berkes & Ross, 2013; Cretney, 2014; Kulig & Botey, 2016). Although communities mediate an individual's perspective of events (Kulig & Botey, 2016), and individuals actualize community programs, the relationship between individual perspectives of community resilience and community resilience as a process is contested (Berkes & Ross, 2013; Kulig & Botey, 2016). To address this research gap, Berkes and Ross (2013) called for better integrating individual psychological well-being with social-ecological resilience. Kulig and Botey (2016) tried to address this relationship by showing how individual leadership provided the opportunity for community members to create social networks, thereby enhancing resilience. Here, I sought to further build on community resilience literature by exploring how individual perspectives relate to community-level resilience, and heighten appreciation for those factors required to enhance community-level resilience to wildfire.

Individual perceptions of increased community strength following wildfire exposure have emerged in the literature (e.g., Blatner et al., 2003; Cox & Perry, 2011; Kulig & Botey, 2016). Perceptions of community strength could indicate an increase in social networks, resource sharing, and a sense of community (e.g., Carroll et al., 2000; Blatner et al., 2003; Cox & Perry, 2011; Kulig & Botey, 2016), all of which boost social capital (Keuschnigg & Wolbring, 2015), and potentially contribute to community-level resilience (Norris et al., 2008; Berkes & Ross, 2013). For instance, Kulig and Botey (2016) found perceptions of increased community strength following a wildfire based on a heightened sense of community and place attachment. However, further research is needed to articulate which factors lead an individual to believe that their community is stronger as a result of wildfire exposure (Kulig & Botey, 2016) and what individuals believing in heightened community strength, which can be considered a positive perception of community outcomes, means for community-level processes.

Thus, my research question was: are individual perceptions of community-level outcomes following wildfire exposure linked to community-level resilience building efforts? To answer this question I observed and analyzed two facilitated group discussions held in the Methow (Washington state) and Bitterroot (Montana) valleys, both of which were exposed to wildfire events between 2014-2019. The participants' conversations shed light on perceptions of wildfire response in the valleys and the connections between individual perceptions and community-level processes, specifically how perceptions of positive community-level outcomes following wildfire exposure may be a result of investment in community-level resilience to wildfire.

Study Areas

Our facilitated group discussions were part of a larger project funded by the Joint Fire Science Program: "Identifying ecological and social resilience in fire-prone landscapes" (JFSP 16-3-01-24). The project aimed to study how residents of two fire-affected valleys in the Western United States were

responding to multiple wildfire events experienced within the past five years (2014-2019). Key informant interviews were conducted in 2016, and a survey on residents' perspectives of their community and wildfire response was conducted in 2018 (see Chapter 2). We defined valley residents as the people residing within census boundaries of areas that were exposed to threatening wildfire events from 2014-2019 (in the Methow Valley, the Carlton Complex Fire in 2014 and the Twisp River Fire in 2015, and in the Bitterroot Valley, the Roaring Lion Fire in 2016 and the Lolo Peak Fire in 2017). We did not delineate specific communities in these areas. Residents of the valley live and work within various towns, thus, "community" could be defined differently according to each resident or even to different researchers. Instead, we chose to describe community-level processes, which are processes that benefit the resilience of residents living together within these valleys. Participants had to live (for the survey and interviews) and work (for the facilitated group discussion and interviews) within census tracts 15 (Missoula County) and 1, 2.01, 3, 4.01, and 5 (Ravalli County) in Montana, and census tracts 9705, 9706, 9707, 9708, 9709, and 9710 in Okanogan County, Washington. In Montana, these census tracts included the towns of Lolo, Stevensville, Hamilton, Victor, and Sula, and in Washington they included the towns of Twisp, Winthrop, and Mazama.

Descriptions of the Valleys and the Wildfires they Experienced

The Methow Valley in Washington state is a wedding, hiking, and mountain biking destination in the summer and a skiing destination in the winter. Bustling with seasonal workers and second home-owners, many of the people living in the valley are seasonal residents. The U.S. Census Bureau estimated 18,659 residents over the age of 18 lived in the Methow Valley in 2018. The population is approximately evenly split between male and females, and the median household income was estimated at $45,800 (U.S. Census Bureau, 2018). Only three roads travel through the valley, making evacuation during wildfire especially harrowing. The valley's rolling topography often conceals approaching flame fronts, enhancing uncertainty and often cultivating a false sense of safety. The Carlton Complex Fire in 2014

was the largest wildfire in Washington State's history at over 256,000 acres in size and burned 353 homes in the Methow Valley. Three wildland firefighters were killed and 120 homes burnt down in the Twisp River Fire in 2015, which was almost 12,000 acres in size.

The Bitterroot Valley in Montana, comprised of Ravalli County and the town of Lolo in our study, is also a popular destination for weddings, hiking, rock climbing, hunting, and horseback riding. The U.S. Census Bureau estimated that 20,237 residents over the age of 18 lived in the Bitterroot Valley study area in 2018. The population of Ravalli County is approximately evenly split between male and females and the median household income was estimated at $48,930 (U.S. Census Bureau, 2018). Evacuations are challenging within concentrated neighborhoods, and one road in the valley allows ingress and egress. Wildfires can be extremely visible in these valleys. The Roaring Lion Fire in 2016 burned over 7,000 acres, led to 500 residences being evacuated, and obliterated sixteen homes. One elderly individual died when trying to evacuate his home during the Roaring Lion Fire. The Lolo Peak Fire in 2017 burned almost 54,000 acres and led to 3,000 people being evacuated and the death of a hotshot wildland firefighter. We felt that the ruralness and population size of the Bitterroot Valley and the impacts of the listed wildfires they experienced were similar enough to those of the Methow Valley that studying both valleys would make for an effective case study on outcomes of wildfire events and possible investment in community-level resilience to wildfire.

Methods

Facilitate Group Discussions

We conducted facilitated group discussions in two valleys that had experienced multiple severe wildfire events between 2014 and 2019. We defined "severe wildfire events" as wildfires that lead to evacuations and loss of financial economy, homes and lives within the identified valleys. Facilitated group discussions can be a valuable tool in unearthing values, local norms, and identifying unique and

common narratives (Kitzinger, 1995; Hughes & DuMont, 2002). By facilitating group discussions around personal and common experiences, group discussions can elucidate “not only what people think but how they think and why they think that way” (Kitzinger, 1999, p. 299). Conversational methods, where the researcher asks open ended questions and lets the participants drive the direction of the conversation that follows, are used in healthcare studies for understanding perceptions of services, care, and health (Basch 1987; Denning & Verschelden, 1993; Duke et al., 1994; Hughes & DuMont 2002; Rabiee 2004; Wong 2008). Linkages between perceptions of community-level outcomes and community-level resilience may emerge from participants when they discuss positive outcomes of experiencing a wildfire and changes in how their valley prepares for wildfire. Facilitated group discussions also have the potential to silence alternative opinions as a result of group dynamics or social power structures embedded within the residents of the valleys. Taking these potential outcomes into consideration, facilitated group discussions may deepen our knowledge concerning connections between individual perspectives and community-level processes.

Facilitated group discussions were led by researchers involved in the Joint Fire Science Program project, including faculty, graduate students, and undergraduates from the University of Montana, faculty from Montana State University, and a researcher from the Aldo Leopold Wilderness Institute. Participants were identified based on their involvement with community-level affairs and wildfire management (e.g., local wildfire and natural resource managers, faith leaders, non-profit and school administrators, media representatives, tourism and recreation business owners, health professionals, and emergency responders). All potential participants were invited via email and were asked to RSVP using a brief online form. The University of Montana granted IRB approval for the facilitated group discussions on January 6th, 2020. Facilitated group discussions were held in public community centers during working hours in January and February 2020, and all participants were informed that their identity would not be attached to their responses to maintain anonymity. To our knowledge, no other

community events occurred during the days and times that the three-hour facilitated group discussions were conducted.

Facilitated Group Discussion Organization

Before the discussions began, researchers gave a 15-minute introduction and presentation on survey and interview results collected from 2016-2019. The purposes of the presentation were to explain the project and to bring research results back to the valleys from which the survey and interview data were collected. Five to eight residents of the valleys sat at each table, and two to three identified themselves as "anchors" while the rest of the participants went to other tables for each set of questions. The participants sitting at a single table were considered a group. Researchers asked participants to respond both as representatives of their affiliations and in light of their personal experiences. Researchers also asked participants to critique ideas not individuals. After researchers asked each of the three sets of questions, participants discussed the set of questions for fifteen-minutes and one participant from each group volunteered to write notes. After each discussion, a volunteer from each group reported key points from their discussion notes to all participants. One to two researchers took notes at each table throughout the discussions. The data utilized for this paper were the notes written by discussion group members and the researchers.

Discussion questions were presented in order:

1) We want to hear directly from you how you and your community have been impacted by wildfire.
    a. How you and your community were negatively impacted
    b. How you and your community were positively impacted
2) How has your community responded to wildfire events…

a. …during wildfire events?

b. …between wildfire events?

3) What stands out to you as things your community could do to better prepare for or respond to future wildfire events?

We asked the question regarding negative impacts from wildfire events (1a.) before the positive impacts question (1b.) because we assumed negative impacts would be more salient to respondents. We also asked the question of response during wildfire events (2a.) before the question of between wildfire events (2b.) because we thought that responses during wildfire events would be more salient to participants. We phrased question 2b. as "between wildfire events" to acknowledge that life after threatening wildfire events has become life between threatening wildfire events in these valleys. If we noticed valley residents not participating in the discussions, we would ask if they had similar or different experiences to the ones already presented by the group.

We tailored criteria developed by Blackstock et al. (2007) to evaluate how effectively and comprehensively the facilitated group discussions answered our questions. We assessed how well the groups stayed focus on the goals of the discussion, how representative our discussions were of voices in the valleys, and how actively engaged each person was in the discussion. In addition, we considered how relationships were developed and conflict managed, if participants felt the sharing of personal and common experiences was beneficial, whether participants felt they had gained a more comprehensive understanding of the issue of wildfire in their valley, and how likely participants were to collectively foster community-level resilience in their valleys after the discussion. For the purposes of our research paper, we analyzed participant responses to better understand the links between individual perceptions of community-level outcomes and community-level resilience to wildfire.

Results

The discussion groups in both valleys stayed focused on the goals of discussion, though each group spent an unbalanced amount of time on the first or second half of questions one and two. The discussions in each of the valleys were attended by several wildfire managers and emergency responders, one school administrator, one media representative, one to two non-profit representatives, one to two business owners, one unaffiliated resident, and one retired firefighter. Of the 30 (Methow Valley) and 15 (Bitterroot Valley) participants, all verbally contributed to each discussion question. Agreements and disagreements were talked through without conflict, and participants thanked the researchers for enabling them to have these conversations.

When engaging in reflective conversations after the facilitated discussions, residents in both valleys voiced that they felt it was a unique to have these kinds of conversations around wildfire. We are unclear how much participants felt they gained in the way of understanding the issue of wildfire in their valleys, and we are unsure how likely each participant will actively engage in conferring community-level resilience to wildfire following the discussions. We acknowledge that participants were not fully representative of the valleys and that their attendance meant they did not permanently leave the valleys because of the wildfire events. Participants spoke to the community-level processes that they personally witnessed during and between wildfire events. For the purposes of this paper, facilitated group discussion participants in both valleys described what they perceived as positive community-level outcomes following wildfire exposure.

Valley residents shared resources during the wildfire events

In the Methow Valley, institutions and individuals shared social, financial, informational, and essential resources with one another during the Carlton Complex and Twisp River fires. One participant said that they saw residents in the valley coming together to “bring needs in to those that need it” and that they saw more “neighbors helping neighbors” during the wildfires. Another participant said that

valley residents got to know their neighbors better during the wildfires. Examples include a local grocery store providing people in the valley with clean water, food, generators, and cash if they needed it during one of the wildfires. People brought needed or lost items to churches, and local churches also provided food and water for valley residents. Participants noted they saw valley residents assisting each other when physically loading vehicles with personal belongings, providing money, and aiding other valley residents during evacuations (especially those who struggled to leave, such as the elderly). Participants also noted that farmers helped each other by hosting each other's livestock and the local feed store provided bales of hay. Participants remarked that people whom evacuated or lost their homes primarily stayed with families or other residents in and outside of the valley. Participants mentioned that residents tried to share as much information as they could with one another, sometimes to the point that there was too much communication and even misinformation circulating on social media. One valley resident summed up discussion responses by saying that experiencing the wildfire loosened the "I'm out here on my own damnit" attitude in the valley.

Participants in the Bitterroot Valley also described social, financial, informational, and essential resource sharing by local institutions and individuals during the Lolo Peak and Roaring Lion Fires. Participants voiced that they saw an uptick in "neighbors helping neighbors" during the wildfire events. For example, participants identified faith groups as providing critical resources and support throughout the wildfire events by opening up their facilities as shelters and providing food and social services. One participant said that valley residents came together to sew and donate quilts to local families. She described this as a way for sewers to both express themselves and distribute resources to valley residents in need. Participants commented on additional resources valley residents shared, including cookies, hay, and boots, which were distributed throughout the valley. Participants also noted that valley residents brought their livestock to the fairgrounds (which participants said were not being used because of the thick smoke in the valley), and young 4-H participants helped take care of these animals

by bringing them food, water, and feed. One participant commented that services provided by the Red Cross were not highly utilized because valley residents heavily invested in providing resources for one another. Another participant remarked that valley residents on a daily basis can be quite insular, but that during wildfire events people communicated much more. Examples included people utilizing social media to post updates and request places to safely shelter their livestock, neighborhoods connecting over who could host and help move livestock and pets, people volunteering to help others evacuate, and people making their trailers available for others to use. Participants voiced that the ways in which valley residents shared resources made them feel more socially connected.

Valley residents perceived increased cooperation between wildfire management agencies

Participants noted that communication and cooperation between wildfire management agencies within the Methow Valley were better during and after the wildfire events than before. Participants said that in general communication between agencies has improved, there is better agency resource tracking, and that there is less focus on jurisdictional boundaries when managing wildfire events. A participant said that agencies have been forced to put differences aside and look for common solutions, and that more wildfire planning is done collaboratively between valley residents, local volunteer fire departments, the Washington Department of Natural Resources, and the United States Forest Service. Wildfire managers who attended the discussions said that incident commanders involved local leadership during the Carlton Complex and Twisp River fires more than they had during previous wildfire events, which they hoped continues. Managers also said there is more funding for prescribed burning because the public supports having wildfire on the landscape. Participants said that this was in part explained by increased efforts to provide the public with information and education around wildfire.

Participants from the Bitterroot Valley also verbalized that they saw improvement in communication and coordination between agencies compared to the wildfires they experienced in 2000. One participant commented that confusion during the initial stages of wildfire events is less than it was twenty years ago because agencies have learned how to coordinate better. They said that back in 1998 agencies only wanted to work within their jurisdictions. For example, one participant commented "I remember the 2000 fires. Fire departments went up to put out a fire and the USFS would say 'no, this is our jurisdiction'." Now, participants said, fire shows how better collaboration can occur between departments in a time of crisis and provides examples of how collaboration could work in non-crisis times. Now during wildfire events, groups and agencies allegedly reach out to each other so that they may work together. Some participants commented that they wish to see more collaboration between wildfire events. A Community Wildfire Preparedness Coordinator was created in Missoula County (in which the town of Lolo resides) by the Missoula County's Office of Emergency Management to further facilitate cross-jurisdiction collaboration in Missoula County during and between wildfire events. Participants noted that this increase in agency collaboration is a result of local agencies learning from recent wildfire events.

Valley residents have seen increased local investment in community-level resilience to wildfire

Informal and formal preparatory actions and new programs have surfaced in the Methow Valley to support wildfire preparedness. Participants noted that these changes were created to address the prolonged effects of experiencing a severe wildfire and with the knowledge that other severe wildfire events will likely occur in the future. Examples of formal and informal wildfire preparatory actions include the Washington Department of Natural Resources recently receiving a grant to support fuels reductions, which locals collectively pushed for. Methow Ready, a non-profit focused on increasing disaster preparedness and in effect boosting resilience in the Methow Valley, is an example of a new institution that was created in 2014 in response to the Carlton Complex Fire. Facilitated group discussion

participants expressed that there is increased motivation in the valley to reduce fuel loads and the chance of fire spreading on their properties. Yet participants also expressed that it can be challenging to create “networks of interconnectedness” because neighbors are not always physically present (there are many non-permanent residents in the Methow Valley, from seasonal workers to second home-owners). Other examples of formal measures include the mayors of Twisp and Winthrop working together more to better prepare their towns for wildfire events and local school staff and administrators being trained to better support students who experience anxiety, trauma, and/or post-traumatic stress disorder around wildfire.

Participants in the Methow Valley also noted changes to infrastructure building regulations and mind shifts that support wildfire preparedness. For example, although all new buildings in Winthrop are supposed to be built in a “western-style”, the new library is not being “westernized”. Rather, the library is being built in a place and with materials that can make it a safe place to go during a wildfire event. Participants also noted that community members and institutions are more aware of the importance of air filters. Residents in the Methow expressed that wildfire season has been normalized, making people think of “wildfire season” on top of summer season. They suggested that this mind shift hasn’t made every community member participate in wildfire preparations, but that it has encouraged more people to prepare for wildfire events and to know where to receive information and resources during a wildfire event.

In the Bitterroot Valley, participants have seen an increase in residents engaging in community-level processes and the development of norms supporting structural and social preparedness for wildfire. For example, participants are now observing entire neighborhoods collectively pressure individual neighbors to reduce fuels around their private properties. This is supposedly because there is a greater recognition that fire can easily travel between properties. A participant also expressed how wildfire makes people feel the need to work together, which has developed relationships that can also

be useful during non-fire incidents. For example, a participant said that “collaborations seem to be popping up all over the place”, including groups that came together to plant trees in burned areas, plan for future wildfire events, and write grants for fuel reduction programs. These are apparently groups that developed in response to the Lolo Peak and Roaring Lion fires. The Ravalli County Collaborative is one group that was created by the Board of Ravalli County Commissioners in spring 2017 following the Roaring Lion Fire and before the Lolo Peak Fire occurred. The Ravalli County Collaborative’s purpose is to bring together people with different and often conflicting viewpoints to talk about opportunities surrounding and concerns with land and natural resource management, with wildfire being one of their primary topics of discussion.

Discussion

Residents in wildfire affected areas have utilized terms such as “stronger” to describe positive community-level outcomes of wildfire exposure (e.g., Blatner et al., 2003; Cox & Perry, 2011; Kulig & Botey, 2016). Although the term “stronger” could mean that wildfire affected areas have increased social capital or enhanced social cohesion at the community-level following wildfire (Carroll et al., 2000; Blatner et al., 2003; Cox & Perry, 2011; Kulig & Botey, 2016), research studies have not articulated whether an individual perceiving their community as stronger following wildfire materializes into community-level resilience building efforts. In this study, I sought to understand how perceptions of community-level outcomes may be connected to processes that boost community-level resilience to wildfire.

The facilitated group discussions elucidated a direct connection between individual perceptions of community-level outcomes and community-level resilience building efforts. I derived three key takeaways from the facilitated group discussions in the Bitterroot and Methow valleys concerning this linkage. One is that individuals, businesses, and organizations sharing knowledge, material resources,

time, and labor during a wildfire event were seen by discussion participants as increasing social cohesion and as a positive community-level outcome. The second is that increased interagency cooperation is seen by valley residents and wildfire managers as improving the efficiency and effectiveness of wildfire management, which makes residents feel more protected and heard. Third, participants saw more community-level social norms being developed to better prepare for wildfire because of past wildfire experiences and because of the relationships created between and during wildfire events. Residents in each valley provided examples of how these takeaways happened in their valleys. Overall, participants indicated that they viewed these changes as positive community-level outcomes following wildfire exposure within the past five years, and utilized terms such as “stronger” and “more connected” repeatedly throughout the discussions to describe their valleys following wildfire events.

Valley residents sharing resources during a threatening event such as wildfire exemplifies the emergence of “altruistic communities”, where there is increased concern for fellow locals experiencing a disastrous event and an escalation of altruistic acts follows (Fritz, 1961; Kaniastay & Norris, 2004). This could serve as a psychological protection for exposed locals in a time of fear, and even heightened social cohesion (Fritz, 1961; Kaniastay & Norris, 2004). Patterns of resource sharing reflect characteristics of the wildfire event, individuals involved, and community-level characteristics, and because resource sharing exists within the sociopolitical context of the area, resource sharing will not necessarily be conducted in an equitable manner (Kaniastay & Norris, 2004). Additionally, Kaniastay and Norris (2004) stated that the rise of an altruistic community will likely unravel, and may not be enough to continue boosting social capital after the immediacy of the disaster has passed. Our facilitated group discussions were conducted in January and February 2020, two and a half to four and a half years after the Bitterroot and Methow valleys, respectively, most recently experienced threatening wildfire events. Because participants continued to reference these acts of sharing as positive and described them as increasing social cohesion and collaboration, altruism in a time of fear may have long-lasting effects on

individuals' sense of community and social cohesion (although it is unclear who did and did not receive the benefits of altruism). From our facilitated group discussions, these perceptions of increased social capital seem to have occurred because valley residents engaged in community-level resilience building efforts both during and between the wildfire events.

Increased communication and cooperation between wildfire management agencies enables cross-jurisdictional strategies on how to manage fuel loads and coordinate wildfire suppression efficiently (Lachapelle & McCool, 2012). Agencies are usually the ones that receive the funds and provide the leadership for fuel reduction programs (Jakes et al., 2007). Wildfire managers participating in the facilitated group discussions noted that because of encouragement and demands received from valley residents, agencies secured more funds for fuel reduction projects. This suggests that residents of the areas are politically invested in community-level preparations for wildfire and that increased agency cooperation and coordination enable residents to feel physically safer. Additionally, wildfire managers participating in the facilitated group discussions live in the valleys they are tasked with protecting from wildfire, and valley residents calling for increased fuel reduction likely further drives managers to engage in cross-agency collaboration to boost such efforts. Therefore, enhanced cross-jurisdictional investment in fuel reduction programs and efficient wildfire responses, as well as individual residents feeling empowered to call on their agencies (Jakes et al., 2007), indicate that community-level resilience building efforts contributed to perceptions of positive community-level outcomes because residents felt safer.

Engaging in wildfire preparedness efforts can empower residents to feel as though they can mitigate future wildfire impacts (Jakes et al., 2007). Residents participating in community-level resilience building efforts, such as fuel mitigation projects with agencies, can increase trust between residents and agencies if residents felt as though the efforts were meaningful (Olsen & Shindler, 2009). Yet much of this trust building between residents and between residents and agencies is predicated on social

relationships that occurred before the wildfire events (LaChapelle & McCool, 2012). Thus, investing in social processes such as community-level cohesion and engagement between wildfire events will likely boost community-level resilience efforts. Overall, discussions suggested that residents engaging in wildfire preparedness efforts can catalyze other residents into reducing fuel and increasing wildfire preparedness due to the development of social norms and social pressure to do so. This boosts community-level resilience and consequentially positive perceptions of community-level outcomes following wildfire.

Overall, participants in the facilitated group discussions indicated that they perceived positive community-level outcomes following wildfire exposure because of increased investment in community-level resilience building efforts. The discussions suggested that perceptions of positive outcomes were due to our three takeaways including increased social cohesion following resource sharing, increased interagency cooperation and investment in fuel mitigation projects, and increased engagement in wildfire preparedness efforts due to social pressure and the development of social norms. Further, sharing resources locally enhanced social network connections that extended outside of the valleys, as residents of the Bitterroot Valley began sharing resources with other communities exposed to wildfire events (i.e., sent quilts and food) and residents of the Methow valley received resources from people in other areas who had experienced wildfire. Taken together, these outcomes suggest that wildfires can be a catalyst for community-level resilience.

In this study, residents have clearly continued to invest in community-level resilience to wildfire several years after the wildfire events, indicating that the “window of opportunity” following disastrous events can be longer than usually assumed. Residents living in wildfire exposed areas may need to have developed social networks and adequate resources to take advantage of “windows of opportunity”. In these fire-affected valleys, contrary to findings from Mockrin, Fishler, and Stewart (2018), large wildfires are not “novel”, but similarly to their findings, there is agency investment in wildfire mitigation to

support investment in “windows of opportunity”. Of course, there are residents of the valleys who have lost interest or are still not interested in investing in community-level resilience to wildfire. Yet the processes that participants shared with us during facilitated group discussions indicates a large local investment in community-level resilience to wildfire. Overall, this suggests that the length of a “window of opportunity” may be predicated upon the social relationships developed during and between wildfire events and access to resources.

From our facilitated group discussions, we saw evidence that people living within wildfire affected areas can and are adapting to wildfire. Wildfire seasons, ignitions, and extent are increasing in the Western United States (Abatzoglou & Williams, 2016). Individual engagement, institutional will, and resource allocation will dictate community-level resilience (Cretney, 2014) to wildfire and the landscapes they are a part of. Participants in the facilitated group discussions spoke to how wildfire management must be “about people’s way of life,” and that the social capital created from resource sharing throughout wildfire events has increased participation and motivation in developing the communication, structural, and personal networks necessary to stay resilient to wildfire. There has also been an increase in institutional will and financial ability to work across jurisdictions and conduct fuel reduction projects. More research is needed on how agencies and institutions invested in the issue of wildfire (i.e., the U.S. Forest Service, state agencies, Congress, city council, volunteer fire departments, etc.) and their political commitment to wildfire suppression and mitigation enables or bars community-level efforts to better live with fire. Community-level resilience efforts support individuals and institutions thriving in the face of challenges (Marschke & Berkes, 2006; Lindberg & Swearingen, 2020) and the actions the residents of the Methow and Bitterroot valleys are taking is more than just wildfire response, it is also about boosting social networks, morale, and general engagement within the valleys.

Wildfire affected residents perceiving positive community-level outcomes following wildfire may serve as a surrogate for community-level resilience (e.g., Carpenter, Westley, & Turner, 2005) and

indicate enhanced adaptive capacities. Community resilience literature generally identifies economic diversity, information distribution, community engagement, strong leadership, and a sense of community as capacities that enable communities to be adaptive, supporting resilience to wildfire (Norris et al., 2008; Kulig et al., 2013; Absher, Vaske, & Lyon, 2013; Kulig & Botey, 2016; Lindberg & Swearingen, 2020). Our findings suggest that residents seeing community-level improvements following wildfire events, including increased social cohesion, interagency cooperation, and local efforts in wildfire preparedness efforts, contribute to perceptions of positive community-level outcomes. In addition, our three key takeaways support many of the facets of community resilience identified in community resilience literature. Although the nature of these data cannot answer whether resources are robust, redundant, and readily accessible (Norris et al., 2008) or to what degrees these perceptions materialize into community-level building efforts, they do indicate that residents of these two valleys are invested in community-level resilience to wildfire as a process. As a note, one of the participants in the Bitterroot said that resource sharing occurred because of the relationships that were developed before the wildfire event. As both the Bitterroot and Methow valleys experienced severe wildfire events around twenty years prior to our research in addition to the last five years, it provides hope that people living in wildfire affected areas can develop strong social networks between and during wildfire events to support community-level resilience to wildfire. Overall, in response to the call from Berkes and Ross (2013) to integrate resilience theories, these takeaways show that wildfire events can catalyze psychological well-being through increased social cohesion, and social-ecological resilience to wildfire through agencies and residents feeling that they have the social support to engage in resilience conferring actions. Although it could be that perceptions of positive community-level outcomes lead to community-level resilience efforts rather than vice versa, this still suggests that positive perceptions of community-level outcomes are associated with investment in community-level resilience conferring efforts. Further

research is needed to assess to what degree perceptions of outcomes actually materialize into community-level resilience building efforts.

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Thesis Conclusion

My thesis research investigated which factors theorized by community resilience literature enable individuals to feel as though their self-defined community thrived during and between wildfire events. The linear regression model I presented in Chapter Two is one of the first studies to empirically test which theorized community resilience factors are actually associated with perceptions of community resilience. I assessed this by modeling which factors were significantly associated with individual perceptions of positive outcomes, utilizing the metric of perceptions of community strength following wildfire events. I did this to investigate which characteristics articulated by the community resilience literature actually enable wildfire affected individuals to feel as though they and their self-defined community are thriving during and between wildfire events. I found that the residents perceiving strong leadership and community engagement as measured in the Index of Perceived Resilience developed by Kulig et al. (2013), residents feeling as though they had access to trusted information sources during wildfire events, adequate protection from wildfire, and a sense of home are strongly associated with perceptions of community-level outcomes and thereby community-level resilience, but other resilience factors such as understanding of risk and a sense of community are not. In addition, perceptions of community-level resilience were more positive in the Methow than the Bitterroot valley, and since the different valleys were controlled for in the model with the 'State' variable, the same factors were associated with perceptions of community-level outcomes in both studied valleys. The model could not answer why the residents of the Methow Valley perceived positive outcomes to a greater degree than the residents of the Bitterroot Valley. This could have been due to the residents of the Methow Valley having greater social cohesion and developed social networks prior to the wildfire events, that community-resilience building efforts were more highly invested in following the wildfire events, or other variables that were not considered in the model, such as to what degree residents were able to visibly see wildfire spread across the landscape. Finally, the resilience factors that

were not included in the final model could still contribute to community-level resilience, but were not strongly associated enough to be considered a priority if researchers and managers wish to invest in community-level resilience.

The final model identified social processes and wildfire management tactics that support psychological well-being during and between wildfire events that may catalyze investment in community-level resilience to wildfire. I would suggest future research to conduct nonparametric, logistical regression analyses in concert with parametric, linear regression analyses to strengthen model findings when utilizing Likert scale data. Additionally, I encourage researchers to investigate other ways of measuring perceptions of outcomes and compare results to my final model, such as conducting a pilot study on what wildfire-affected residents saw as being positive community-level outcomes and then modeling which community-level resilience and personal wildfire factors were associated with those outcomes.

In Chapter Three I found that perceptions of positive community-level outcomes following wildfire events were associated with community-level resilience building efforts. Conducting further research on how those perceptions actually did or did not materialize into community-level outcomes is warranted. Additionally, more thorough understandings of which voices may not have been included in conversations and community-level efforts is necessary to better understand which social actors are benefitting from community-level resilience efforts, and which ones are not. All in all, community resilience literature will benefit by continuing to assess which social and wildfire processes are associated with perceptions of community-level outcomes via empirical evidence. This research will benefit managers by specifying how managers may support and assess community-level resilience to wildfire, and may encourage agencies to incentivize managers investing in social processes such as trust and effective communication.

In my research I utilized community resilience theory to assess perceptions of community-level resilience. I did not define community, as in the era of instant communication and global social networks each individual can have multiple communities undefined by geography. I applied the term "community-level" to reference actions and sentiments that benefit a substantial number of people living within a fire-susceptible area, as wildfires do not recognize boundaries and the action of a single individual can largely affect to what degree neighbors and residents in the area at large are exposed to wildfire. Researchers, politicians, and residents continue to utilize the concept "community" when discussing resilience because it speaks to residents in an area feeling that they are more than a conglomeration of individuals but rather a social unit with emotional ties. The complexity of defining community and objectively assessing community-level resilience is likely less productive than studying the processes that enable residents to invest in community-level resilience efforts in ways they see as positive and productive. Therefore, assessing perceptions of outcomes can give researchers and managers a better idea of how invested residents are in community-level resilience and to what degree they see resilience efforts as contributing to their personal well-being. If exposure to wildfire encourages residents to engage in and reflect on resilience conferring efforts, then wildfire may be considered a catalyst for community-level resilience.

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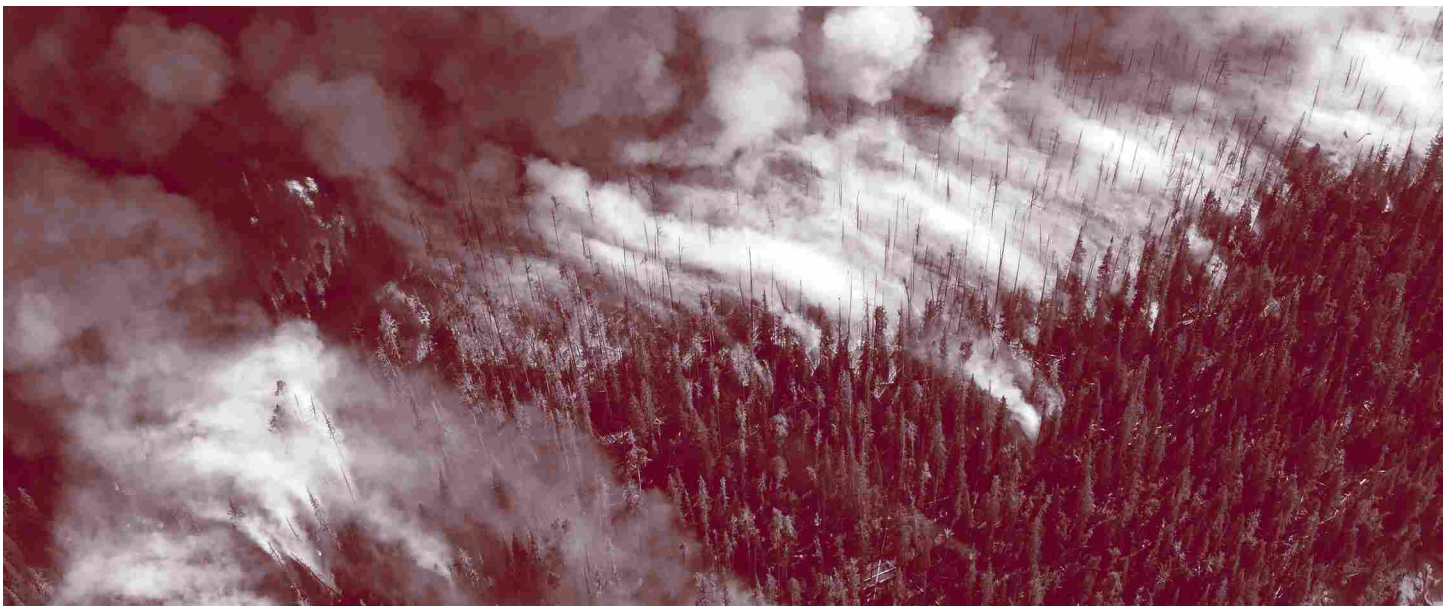
BUREAU OF BUSINESS AND ECONOMIC RESEARCH
UNIVERSITY OF MONTANA



2018-2019 WILDFIRE IN THE WEST SURVEY

METHODS SUMMARY
JANUARY 2019

W.A. Franke College of Forestry and Conservation
University of Montana
Missoula, Montana 59812

Contents

Acknowledgements

The research team at University of Montana's Bureau of Business and Economic Research (BBER) owes thanks to Dr. Libby Metcalf and Dr. Alexander Metcalf of the W. A. Franke College of Forestry and Conservation at the University of Montana. As the project's principal investigators, their skill and humor made this project very fun to work on. In addition, primary data like those obtained for this project do not collect themselves. Ms. Janet Stevens and Mrs. Ramona Alspaugh of BBER must be recognized for their hard and thorough work on this project.

John Baldridge
Bureau of Business and Economic Research
University of Montana
January 18, 2019

Methods Summary

This report presents a description of the methods used to collect and process the data for the 2018-2019 Wildfire in the West Survey. This description is designed to assist data analysts. The report is divided into three parts. First, the methods used for data collection and processing are described. Second, a list of references that document and expand on the methods used is provided. Finally, the questionnaire is presented.

Survey Administration

University of Montana's Bureau of Business and Economic Research (BBER) administered the survey on behalf of the W.A. Franke College of Forestry and Conservation from November 3, 2018, through January 8, 2019. The survey was administered by mail and responses were collected over the internet or via a hardcopy questionnaire. (Dillman, Smyth, & Christian, 2014) Sampled potential respondents received up to 4 mail contacts during the survey:

1. An introductory letter inviting participation via an internet link provided;
2. A follow-up letter thanking respondents and reminding nonrespondents that they could participate via the internet link provided;
3. A 8.5" x 11' questionnaire packet mailed to non-respondents only inviting participation via an internet link provided or by completing a hardcopy questionnaire and returning it in the stamped envelope provided;
4. A second 8.5" x 11' questionnaire packet mailed to non-respondents only inviting participation via an internet link provided or by completing a hardcopy questionnaire and returning it in the stamped envelope provided.

Questionnaire Design

The questionnaire was designed by principal investigator Dr. Libby Metcalf and Dr. Alexander Metcalf of the W. A. Franke College of Forestry and Conservation (CFC) at the University of Montana. BBER formatted the hardcopy questionnaire. In addition, BBER programmed and tested the internet version of the questionnaire using software provided by Qualtrics, Inc. Dr. Libby Metcalf and Dr. Alex Metcalf of the CFC were the final approval authorities for the questionnaire. A copy of the final questionnaire may be found in the appendix of this document.

Sampling

BBER sampled 3,000 potential respondents, 1,500 from each state's study area. Sampling was conducted using an addressed-based, random sample of residences purchased from SSI, Inc. (Link, Battaglia, Frankel, Mokdad, & Rao, 2008) (Smyth, Dillman, Christian, & O'Neill, 2010) (American Association for Public Opinion Research, 2016) Within household random sampling was conducted using the most recent birthday method. (Dillman, Smyth, & Christian, 2014) (Battaglia, Link, Frankel, Osborn, & Mokdad, 2005) The study population was adults (ages 18+) (U.S. Census Bureau, 2018) who lived in an occupied dwelling that was listed on the U.S. Postal Service's Computerized Delivery Sequence File. These adults were sampled from 12 U.S. Census Bureau census tracts that coincided with the study region (see Table 1 below). This population

differs from all adults as it excludes institutionalized persons, homeless persons, and those absent during the survey period.

Table 1: Geographic Sample Definition

STATE	COUNTY	CENSUS TRACT	2017 U.S. CENSUS POPULATION AGE 18 +
Montana	Missoula	15	4,871
Montana	Ravalli	1	3,078
Montana	Ravalli	2.01	2,919
Montana	Ravalli	3	2,384
Montana	Ravalli	4.01	1,948
Montana	Ravalli	5	5,037
Washington	Okanogan	9705	2,028
Washington	Okanogan	9706	4,798
Washington	Okanogan	9707	3,149
Washington	Okanogan	9708	3,825
Washington	Okanogan	9709	1,604
Washington	Okanogan	9710	3,255
TOTAL			38,896

The study region is drawn from the states of Montana and Washington, and is represented by the maps below, see Figure 1.

Figure 1: Study Region Maps, MT and WA respectively

Sampling Error

The 771 responses to this survey yielded an overall 95% confidence interval of +/- 5.8%. This means that if the survey were administered 100 times, in 95 of the administrations an estimated proportion of 50% would be found +/- 5.8%. The standard error for a proportion of 50% estimated from this survey is 3.0%. Data users should take care to calculate standard errors and confidence intervals for these data using a statistical software package that can account for the design of the survey. One reason for care is that the standard errors for this survey are increased by the weights used to calculate point estimates. (Kish & Frankel, 1974) (Kish, 1992) (Davern & Strief, 2008) (Young & Johnson, 2012) The study design increased standard errors by a factor of 1.649. This factor is defined as the actual survey standard error divided by the standard error of the survey given simple random sampling with no weighting. (Kish, 1995) For reference, the 95% confidence interval for a proportion of 50% among respondents from Montana is +/- 8% and among respondents from Washington is +/- 8.5%.

Data Collection Outcomes

Of the 3,000 potential respondents sampled 771 responded. Table 2 below summarizes the outcomes of the data collection process:

Table 2: Data Collection Outcome Summary

DATA COLLECTION OUTCOME CATEGORY	FINAL AAPOR DISPOSITION CODE	N
Interview (Category 1)		
Complete	1.0/1.10	771
Partial	1.2000	0
Eligible, non-interview (Category 2)		
Refusal	2.1000	18
Unknown eligibility, non-interview (Category 3)		
Nothing returned or USPS* statuses: attempted not known, no mail receptacle, temporarily absent	3.1000	2,012
Not eligible (Category 4)		
No eligible respondent; USPS status: vacant	4.7000	199
Total sample used		3,000

* USPS – United States Postal Service delivery status.

Table 2 lists data collection outcomes by categories and codes established by the American Association of Public Opinion Research. (American Association for Public Opinion Research, 2016) The response rate for this survey is 32.2%, calculated using AAPOR response rate formula 3 where e = 0.799. This response rate is typical for rigorously conducted, address-sampled, mail and internet-administered surveys. (Dillman, Smyth, & Christian, 2014)

The Respondents

Table 3 below describes the respondents. 2017 U.S. Census Bureau American Community Survey 5-year population proportions (ages 18 +) for the study population of 38,896 persons are provided for context.

Table 3: Respondent Demographics

CHARACTERISTIC		2017 ACS 5-YEAR ESTIMATE (%)	UNWEIGHTED RESPONSES (%)	WEIGHTED RESPONSES (%)
Gender	Male	48.2%	53.4%	48.2%
	Female	51.6%	46.4%	51.6%
	Other	*	*	*
Age	18-34	21.4%	7.5%	21.4%
	35-49	21.6%	17.9%	21.6%
	50-64	29.4%	31.4%	29.4%
	65 +	27.6%	43.2%	27.6%
Education Attainment	HS diploma or less	44.0%	17.0%	44.0%
	Some college or AA degree	29.6%	38.3%	29.6%
	Bachelors +	26.4%	44.7%	26.4%
State	Montana	52.0%	58.6%	52.0%
	Washington	48.0%	41.4%	48.0%

* Omitted because fewer than 5 responses were received.

Data Set Preparation

Following collection and data entry, 100% of mailed questionnaires were verified for data entry accuracy. Appropriate data labels were added as well as composite variables and flags to facilitate analysis. Missing values for the weighting variables, necessary for comparison to the 2017 ACS 5-year estimates, were imputed using the hot deck method which substitutes the responses of similar cases for missing data. (Andridge & Little, 2010) Data were processed using three statistical software packages: IBM SPSS Statistics Version 25 (2017), SAS Version 9.4 (2016), and Statistics Canada's G-EST Version 2.01 (2017).

Weighting

The survey estimates presented in this study are produced using survey weights. Survey weights improve the accuracy of estimates and help to ensure that the survey is representative of the study population. The consensus in the scientific literature is that correctly constructed and applied weights should be used to produce statistics that describe survey data. (Kish & Frankel, 1974) (Rao, Hidiroglou, Yung, & Kovacevic, 2010) (Valliant, Dever, & Kreuter, 2013) (Battaglia, et al., 2016) (Haziza & Beaumont, 2017)

Weights for the 2018-2019 Wildfire in the West Survey were calculated using a three-step process that is also widely accepted in survey research literature. (Haziza & Beaumont, 2017) (Battaglia, et al., 2016) (Haziza & Lesage, 2016) (Lavallee & Beaumont, 2016) (Valliant, Dever, & Kreuter, 2013) In step 1 a base weight was calculated to account for the probability of selection of each individual in

the sample. The population control total was based on the U.S. Census Bureau's American Community Survey 2017 5-year estimate for the population of persons age 18 and older. (U.S. Census Bureau, 2018) In step 2 the base weight was modified to adjust for nonresponse. (Haziza & Lesage, 2016) (Battaglia, et al., 2016) (Brick, 2013) (Kreuter & Olson, 2013) (Olson, 2013) (Valliant, Dever, & Kreuter, 2013) In step 3 the nonresponse-adjusted weight was calibrated to population control totals derived from the U.S. Census Bureau's American Community Survey 2017 5-year estimates for the population of persons age 18 and older (Haziza & Beaumont, 2017) (Lavallee & Beaumont, 2016) (Valliant, Dever, & Kreuter, 2013) (Sarndal, 2007) (Kalton & Flores-Cervantes, 2003).

Survey weight calibration was conducted using the Gest_Calibration module of Generalized Estimation System version 2.01 (March 2017) developed by Statistics Canada. The 2018-2019 Wildfire in the West Survey weight was calibrated to population control totals by:

1. U.S. Census Bureau population (ages 18 +) for the study area in each state
2. Gender
3. Age
4. Educational attainment

Two survey weights were provided by BBER in the dataset: a population weight useful for estimating the number of adults in the study population who have a particular characteristic, and a sample weight needed for some statistical packages to calculate accurate standard errors.

In the remaining sections of this report you will find references that expand on the methods used for this survey and the survey's questionnaire.

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Appendix B: Wildfire in the West Survey Questionnaire

UNIVERSITY OF MONTANA

2018

Wildfire in the West

START HERE

Q1. Are you the adult age 18 or older in your household who will have the next birthday?

Mark one button (X)

0 Yes → Please continue.

0 No → Please have the adult in your household who will have the next birthday complete the survey.

Thank you for taking the time to take this survey. Your responses will help researchers and fire managers across the West better respond to future wildfire events.

Wildfire can affect people differently, even when they live in the same community. The following questions ask about your personal experiences with wildfire. Some questions will ask you to think only about events during the last 5 years.

Administered by: University of Montana Bureau of Business and Economic Research

Sponsored by: University of Montana W.A. Franke College of Forestry & Conservation

11/1/2018

UNIVERSITY OF MONTANA

Q2. Have you <u>ever</u> personally lived through a wildfire event? Please mark one button (X) below that best represents your experience.

- **0** No, never
- **0** Yes, but I have not been impacted
- **0** Yes, and I have been slightly impacted
- **0** Yes, and I have been moderately impacted
- **0** Yes, and I have been severely impacted

Q3. We are interested in how you have been affected by any wildfire events in the <u>past 5 years</u>. Please indicate how strongly you agree or disagree with the following statements. Please mark one button (X) for each item.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)	Not applicable
a. Overall, I am satisfied with how my community responded to wildfire.	**0**	**0**	**0**	**0**	**0**	**0**
b. Wildfire has negatively affected my life.	**0**	**0**	**0**	**0**	**0**	**0**
c. Wildfire events made my community stronger.	**0**	**0**	**0**	**0**	**0**	**0**
d. Despite any losses I am generally OK after wildfire events.	**0**	**0**	**0**	**0**	**0**	**0**
e. My pets and livestock were adequately protected.	**0**	**0**	**0**	**0**	**0**	**0**
f. My property was adequately protected.	**0**	**0**	**0**	**0**	**0**	**0**
g. Resident lives were adequately protected.	**0**	**0**	**0**	**0**	**0**	**0**
h. The look of the landscape is worse now.	**0**	**0**	**0**	**0**	**0**	**0**
i. Wildfire has negatively impacted my recreation opportunities.	**0**	**0**	**0**	**0**	**0**	**0**
j. I lost wages due to wildfire.	**0**	**0**	**0**	**0**	**0**	**0**
k. My health was negatively impacted by wildfires.	**0**	**0**	**0**	**0**	**0**	**0**

UNIVERSITY OF MONTANA

Q4. Have you had to evacuate due to a wildfire in the <u>past 5 years</u>? Please mark one button (X).

No, never	Yes, once	Yes, more than once
0	**0**	**0**

Q5. In your own words, please share the most significant ways you have been impacted by wildfire in the <u>past 5 years</u>.

_____

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Q6. In preparation for wildfire, some people establish different types of personal plans. First, please indicate if you <u>currently</u> have each of the following plans. Second, please rate whether you believe it is personally important to <u>you</u> to have each type of plan. Please mark one button (X) for each item in each area.

	Have established?		How important is it for you to have this type of plan?				
	Yes	No	Very unimportant (1)	Somewhat unimportant (2)	Neither unimportant nor important (3)	Somewhat important (4)	Very important (5)
a. Personal evacuation plan	0	0	0	0	0	0	0
b. Plan to protect valuables	0	0	0	0	0	0	0
c. Plan to protect animals	0	0	0	0	0	0	0
d. Plan to protect property	0	0	0	0	0	0	0
e. Plan with neighbors in case of fire	0	0	0	0	0	0	0

Q7. Please think about your current community as a whole and rate the quality of each of the following. Please mark one button (X) for each item.

	Far below average (1)	Somewhat below average (2)	Average (3)	Somewhat above average (4)	Far above average (5)
a. Road access for first/fire responders	0	0	0	0	0
b. Adequately marked roads	0	0	0	0	0
c. Community-wide plan for wildfire	0	0	0	0	0
d. Local fire responders	0	0	0	0	0
e. State fire responders	0	0	0	0	0
f. Federal fire responders	0	0	0	0	0

Q8. Please rate how you feel about the following statements regarding your current community. Please mark one button (X) for each item.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
a. The physical environment in my community negatively affects my health.	0	0	0	0	0
b. People in my community help out one another.	0	0	0	0	0
c. Residents in my community feel isolated from other parts of the state.	0	0	0	0	0
d. The people in my community are open to new ideas.	0	0	0	0	0
e. People who live in my community have similar values or ideas.	0	0	0	0	0
f. There is a sense of pride among people in my community.	0	0	0	0	0
g. Leaders in my community listen to the residents.	0	0	0	0	0
h. My community has strong community leadership.	0	0	0	0	0
i. The changes in my community are positive.	0	0	0	0	0
j. When a problem occurs, community members are able to deal with it.	0	0	0	0	0
k. Residents of my community participate in community events.	0	0	0	0	0
l. I wouldn't change anything about my community.	0	0	0	0	0
m. I wouldn't change anything about the environment around where I live.	0	0	0	0	0

Q9. Please rate how strongly you agree or disagree with the following statements about your current community. Please mark one button (X) for each item.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
a. I feel at home in this neighborhood.	0	0	0	0	0
b. This community is a good place for me to live.	0	0	0	0	0
c. My community is a special place to live.	0	0	0	0	0
d. I recognize most of the people who live in my community.	0	0	0	0	0
e. Most of my neighbors know me.	0	0	0	0	0
f. People in my neighborhood generally get along with each other.	0	0	0	0	0
g. People in my neighborhood share the same values.	0	0	0	0	0
h. My neighbors and I want the same things from this community.	0	0	0	0	0
i. I feel a strong sense of community with my neighbors.	0	0	0	0	0
j. If there is a problem in my neighborhood, people who live here get it solved.	0	0	0	0	0
k. I care about what my neighbors think about my actions.	0	0	0	0	0
l. I have an influence over what this community is like.	0	0	0	0	0

Q10. While thinking about wildfire events in your community in the <u>past 5 years</u>, please indicate how strongly you agree or disagree with the following statements about information and communication sources. Please mark one button (X) for each item.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)	Not applicable
a. I accurately understood the wildfire risk in my area before wildfires occurred..	0	0	0	0	0	0
b. I received adequate warning about wildfires.	0	0	0	0	0	0
c. I received adequate information about how to prepare for wildfire.	0	0	0	0	0	0
d. Local news coverage was helpful.	0	0	0	0	0	0
e. My communications with fire managers made me feel cared for.	0	0	0	0	0	0
f. I was able to get the information I needed.	0	0	0	0	0	0
g. I knew how to get the help I needed.	0	0	0	0	0	0
h. Manned information booths were helpful sources of information about wildfire events.	0	0	0	0	0	0
i. Public information boards were helpful sources of information about wildfire events.	0	0	0	0	0	0
j. Public meetings were worthwhile.	0	0	0	0	0	0
k. I received adequate emotional support following wildfire events.	0	0	0	0	0	0
l. I received the support I needed to repair/replace property damaged during wildfire events.	0	0	0	0	0	0
m. I was able to find the financial resources I needed to recover from wildfire events.	0	0	0	0	0	0

Q11. Please indicate whether or not you found the following information sources <u>helpful</u> during any wildfire event in the <u>past 5 years</u>. Please mark one button (X) for each item.

	Unhelpful (1)	Somewhat helpful (2)	Very helpful (3)	Did Not Use
a. Facebook	0	0	0	0
b. Instagram	0	0	0	0
c. Twitter	0	0	0	0
d. Television	0	0	0	0
e. AM/FM Radio	0	0	0	0
f. Other Radio	0	0	0	0
g. Neighbors	0	0	0	0
h. Fire responders	0	0	0	0
i. Other internet websites	0	0	0	0
j. Unmanned information signs/kiosks	0	0	0	0
k. manned information booths	0	0	0	0
l. Public meetings	0	0	0	0

Q12. Did you ever lose cellphone coverage during a wildfire event in the <u>past 5 years</u>? Please mark one button (X).

No, never	Yes, one time	Yes, more than once	Not Applicable
0	0	0	0

Q13. Did you ever lose your internet connection during a wildfire event in the <u>past 5 years</u>? Please mark one button (X).

No, never	Yes, one time	Yes, more than once	Not Applicable
0	0	0	0

Q14. Did you ever lose your television service during a wildfire event in the past 5 years? Please mark one button (X).

No, never	Yes, one time	Yes, more than once	Not Applicable
0	**0**	**0**	**0**

Q15. If you have suggestions for how information and communication could be improved during future fire events, please include them in the space provided:

_____

_____

_____

_____

_____

_____

_____

To close, we have a few demographic questions about you and your household.

Q16. What is your gender? Please mark one button (X) below.

Mark one button (X)	
0	Male
0	Female
0	Other

Q17. In what year were you born? Please print the year in the box below.

Year _____

Q18. How many years have you lived in your current community? Please print the number of years in the box below.

Years ☐

Q19. Do you rent or own your property? Please mark one button (X) below.

Mark one button (X)	
0	Rental
0	Own

Q20. In a typical year, how many months do you spend at this address? Please print the number of months per year in the box below.

Months 1-12 ☐

Q21. Is your property 0.5 acres in size or larger? Please mark one button (X) below.

Mark one button (X)	
0	Yes
0	No

Q22. What is the highest education you have achieved? Please mark one button (X) below.

Mark one button (X)	
0	Less than high school
0	High school graduate/ GED
0	Vocational or Technical School certificate
0	Some college
0	4 year college degree
0	Graduate degree

Q23. What is your approximate annual household income, before taxes? Please mark one button (X) below.

Mark one button (X)	
0	Less than $10,000
0	$10,000 to $24,999
0	$25,000-$49,999
0	$50,000-$74,999
0	$75,000-$99,999
0	$100,000-$124,999
0	$125,000-$149,999
0	$150,000 or more
0	Choose not to answer

Q24. Including yourself, how many people live in your household? Please print the number in the box below.

People in household ☐

Q25. Thank you for completing this survey questionnaire. If you have any additional comments, please include them in the space below:

_____

_____

_____

_____

_____

_____

_____

Thank you for your help with this important research!

BUREAU OF BUSINESS AND ECONOMIC RESEARCH
UNIVERSITY OF MONTANA

Wildfire in the West 2018

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