



Research

Where you stand depends on where you sit: qualitative inquiry into notions of fire adaptation

Hannah Brenkert-Smith¹, James R. Meldrum², Patricia A. Champ³ and Christopher M. Barth⁴

ABSTRACT. Wildfire and the threat it poses to society represents an example of the complex, dynamic relationship between social and ecological systems. Increasingly, wildfire adaptation is posited as a pathway to shift the approach to fire from a suppression paradigm that seeks to control fire to a paradigm that focuses on “living with” and “adapting to” wildfire. In this study, we seek insights into what it means to adapt to wildfire from a range of stakeholders whose efforts contribute to the management of wildfire. Study participants provided insights into the meaning, relevance, and use of the concept of fire adaptation as it relates to their wildfire-related activities. A key finding of this investigation suggests that social scale is of key importance in the conceptualization and understanding of adaptation for participating stakeholders. Indeed, where you stand in terms of understandings of fire adaptation depends in large part on where you sit.

Key Words: *fire adaptation; hazards and disasters; social-ecological systems; wildfire risk*

INTRODUCTION

The National Cohesive Wildland Fire Management Strategy (National Cohesive Strategy 2011), the guiding document for U. S. federal forest, land, and fire management agencies, highlights creating “fire-adapted communities” as one of three core goals that support “living with” and “adapting to” wildfire. As such, focus on fire adaptation seeks to reduce the unintended and exacerbated threats to human lives and values, and the escalating costs that result from fire suppression (Busenburg 2004, Mortiz et al. 2014, Olson et al. 2015, USFS 2015). This shift from an almost complete focus on suppression reflects evolving understandings of wildfire (Allen and Gould 1986, Carroll et al. 2007, Hammer et al. 2009, Lockwood 2010, Schoennagel et al. 2017), which also emphasize addressing climate change-related effects on forest conditions and wildfire behavior (Jolly et al. 2015), and demographic shifts that exacerbate risk to lives and values at risk in the expanding wildland–urban interface (WUI) (Westerling et al. 2006, Stephens et al. 2013, Rasker 2015, Knorr et al. 2016). The policy explicitly recognizes the unsustainability of the wildfire suppression approach (Olson et al. 2015). Today, federal agencies and other fire management organizations that grapple with the unintended consequences of past approaches (Stephens and Ruth 2005, Steelman and Burke 2007, Pyne 2015, Fischer et al. 2016) increasingly unite around a fire management policy that aims to “restore and maintain resilient ecosystems, create fire-adapted communities, and respond to wildland fire while keeping communities safe” (Tidwell 2013).

Narratives about social and ecological problems reflect societal understandings of critical dilemmas, while shifts in narratives highlight social processes by which problems may be redefined. As a problem definition changes, new understandings set in motion critical framings that shape the policies and programs designed to address the problem (Stallings 1995). The National Cohesive Strategy (2011) articulates a narrative constructed through a collaborative process that includes government and nongovernmental entities “to seek national, all-lands solutions to wildland fire management issues.” While federal agencies are

critical stakeholders who play central roles in these processes, they do not hold a monopoly on meaning, and stakeholders at different social scales contribute and respond to and even contest dominant definitions (Berger and Luckmann 1991). Differing conceptualizations among critical stakeholders could result in missed opportunities for communication and coordination that may serve as barriers to achieving intended goals.

While the ecological sciences have long attended to the concept of fire adaptation as it relates to ecological systems (Kozlowski and Ahlgren 1974), the use of fire adaptation as a concept related to social systems is relatively recent. The broader literature on the social dimensions of adaptation and resilience builds on the ecological foundations but highlights dilemmas associated with social scale from individual psychological capacities (Tugade et al. 2004) to community characteristics and capacities (Norris et al. 2008) that function as critical components in social processes required for adaptation. Broadly, resilience, or the ability of social units to cope with and change in response to disruption, requires adaptations (Adger 2000), regardless of the social scale at which it occurs. Further, relevant social scales may or may not correspond to specific sectors. In the case of wildland fire, the sectors engaged to undertake public outreach and education/incentive programs, land and resource management, and fire suppression operate largely at different social, spatial, and temporal scales. Spatial and temporal disconnects have been noted to rest within the very policies intended to attend to the current wildfire dilemmas (Stelman 2016).

The forest and fire management organizations leading fire adaptation efforts have developed guidance documents that articulate the basic tenets of what it means to adapt to wildfire.^[1] However, it is important to understand what “adaptation” in the wildfire context means to stakeholders and whether the concept translates from policy to implementation across the different scales at which wildfire management activities are occurring. We therefore focus on a core question: what does the concept of wildfire adaptation mean to stakeholders who are engaged across

¹Institute of Behavioral Science, University of Colorado, Boulder, Colo., USA, ²U.S. Geological Survey, Fort Collins Science Center, ³USDA Forest Service, Rocky Mountain Research Station, ⁴Bureau of Land Management

the continuum of wildfire leadership from policy to program implementation? We present findings from indepth interviews with stakeholders whose efforts contribute to the management of the wildfire problem in a range of ways. Study participants provided insights into the emergence and implementation of the concept of fire adaptation as well as how the concept is currently operating among three stakeholder groups. These groups are characterized by three different programmatic scales: national-level leadership represents a range of agencies that are engaged in efforts from conceptualizing fire-adapted communities to managing suppression resources, regional leadership provides expertise and organizing capacity to support local wildfire-related efforts across multiple fire-prone counties, and local leaders who work on risk reduction efforts with communities and with residents (one-on-one) who live in fire-prone communities. We use a “constructing social problems” approach (Spector and Kitsuse 1987) to investigate stakeholder understanding of fire adaptation in their wildfire work. Key findings from this study suggest that there was a broad, shared understanding of fire adaptation; however, there are challenges in translating policy into practice, and scale is of key importance in the conceptualization and understanding of adaptation for participating stakeholders. Indeed, where you stand in terms of understandings of fire adaptation depends in large part on where you sit.

Background and literature

Wildfire as a social-ecological system

Wildfire and the threat it poses to society represents an example of the complex, dynamic relationship between social and ecological systems (Fischer et al. 2016, Steelman 2016). Understanding this relationship as an integrated social-ecological system (SES) highlights the ways in which the human and biophysical subsystems are engaged in ongoing interaction rather than as distinct systems that can be managed separately (Gallopini 1991). While environmental management decisions tend to privilege the ecological subsystem of the SES (Landres et al. 1999), the fire suppression strategy appears to privilege the protection of the social system, with unintended consequences for the entire SES (Pyne 2015). Indeed, the history of fire exclusion for the sake of public safety resulted in significantly altered ecological functions and conditions, which subsequently exacerbated threats and potential disruption to the social system (USDA and USDI 2014). While the ecological impacts are not uniform (Parisien et al. 2012, Mortiz et al. 2014) and fuel treatments must reflect this variation (Schoennagel et al. 2017), the largely successful control of fire has played an important role in shaping social assumptions about the place of fire on the landscape and in WUI communities. Assumptions about the place of fire on the landscape may not be specifically articulated; however, continued increases in fire suppression expenditures (Gude et al. 2013, USFS 2015) provide a clear signal to society that organizations are committed to preventing and suppressing wildfire events.

Despite a history of fire suppression, the WUI has not been safe from disaster (Busenburg 2004, Mortiz et al. 2014). History is replete with examples of failed attempts to control nature. The development and expansion of the levy system in the United States to control the Mississippi River is a well-documented

example of efforts to use technological approaches to control nature that resulted in unintended social costs. In this case, the levy system resulted in increased development and vulnerability in flood-prone areas that increased risk (McPhee 1989, O'Neill 2006). The history of wildfire suppression and fire suppression mirrors this path in which technological innovation in fire management yielded systemic reliance upon the exclusion of wildfire, with unintended consequences and subsequently increasing threats to social and ecological systems (USDA and USDI 2014, Schoennagel et al. 2017).

Extreme events, such as wildland fire disasters, are noted for their negative outcomes but also allow for windows of opportunity to identify steps to reduce future losses (Seneviratne et al. 2012). In other words, extreme events provide opportunities to reimagine the SES in ways that take the dynamic interplay between the social and ecological systems into account. Reimagining the wildfire SES may occur in multiple ways, from shifts in the ways the social system engages suppression strategies to the ways the social system engages approaches to risk reduction in anticipation of fires on the ground. Indeed, such opportunities may allow environmental and natural resource management strategies to meet up with hazards and disaster management (and research) and to identify both shorter term and smaller scale risk reduction, as well as longer term and broader scale adaptation efforts (see Kousky 2014).

Research on social dimensions of disruptions at the intersection of the social and ecological subsystems includes considerations of short-term, hazard-related coping in response to abrupt changes (Burton 1993, Tierney et al. 2001) as well as longer term adaptations that result in social transformations in response to environmental change (Rodin 2014, Tierney 2014). Put simply, human or societal coping action, in the form of mitigation and preparedness actions, reduces impacts, while adaptive action seeks to reduce vulnerabilities and increase resilience by shifting the system (Adger et al. 2005, IPCC 2014). As such, individual or household action may look different from community action (or other collective scales) but may rest on the same intent to reduce risk. As has been demonstrated in the climate adaptation field, the social processes that facilitate adaptation are complex because they involve multiscale and multisectoral processes. Ultimately, such systemic shifts may result in increased social resilience, imagined as the potential to respond to disruption with a bounce-back to previous conditions or a bounce-forward that takes previous vulnerabilities into account (Tierney 2015, Kelman et al. 2016). Temporal and social scale considerations required for short- and long-term responses vary widely, though the fundamental options in response to environmental changes available to society remain within a relatively limited scope. They include share the loss, bear the loss, modify the event, prevent the effects, and change use or location (Burton 1993). These strategies are consistent with a central goal to “decrease negative effects and increase the benefits from a hazard” (Adger et al. 2009). Such strategies, however, are not equally available across society, as it is apparent that disparate vulnerabilities (i.e., exposure and sensitivity to disruptions) (Cutter and Emrich 2006) as well as coping capacity for shorter term disruptions and adaptive capacity for more long-term and sustainable adjustments vary and point to very real societal limits (Smit and Wandel 2006, Adger et al. 2009, Paveglio et al. 2009, 2015).

In environmental dilemmas, pulling the SES apart is nearly impossible and largely undesirable. In the case of wildland fire, the extensive role social systems have played in the systematic exclusion of wildfire from ecological systems highlights this interdependence. Indeed, the concerted efforts to suppress wildfire to protect communities at risk has resulted in the development of extensive social systems that are dedicated to continued exclusion of wildfire from populated landscapes. These systems range from local fire protection districts to a complex and highly structured Incident Command System that brings expertise and extensive resources to protect lives and properties in harm's way (Lueck 2012). Further, the ongoing dedication of such resources rests upon a history of suppression and assumptions about societal expectations of protection. The alteration to ecological conditions and functions has, in many cases, exacerbated threats and potential disruption to the social system. A central challenge, however, remains in understanding these as broad processes in order to highlight the social systems built on assumptions of fire suppression without overgeneralizing the ecological effects.

Fire adaptation

Despite the fact that the broader research related to social-ecological systems articulates dimensions of social adaptation, most work on the social dimensions of wildfire rests within the framework of the traditional hazards/disaster cycle (Burton 1993). As such, research on the social system tends to be parsed into broad efforts to articulate the policy approaches that undergird the wildland fire dilemma (Steelman and Burke 2007) or more specific research efforts that identify behavioral response. Research on behavioral response generally focuses on shorter term coping behaviors before, during, and after stages of the disaster cycle, and includes mitigation activities and determinants of such hazard-related behaviors before an event (e.g., structural improvements, vegetation reduction around the home) (Martin et al. 2009, Brenkert-Smith et al. 2012, Dickinson et al. 2015) and preparedness activities and their determinants (e.g., evacuation planning) (Cohn et al. 2006, Jakes et al. 2007, Paveglio et al. 2010, McCaffrey et al. 2015). And finally, limited work examines factors that influence the trajectories of recovery and likelihood of rebuilding after a disaster (Mockrin et al. 2015) that may contribute to a shift from coping to adaptation. Notably, some research argues that behaviors that are typically characterized as part of the hazard/disaster cycle function as key tenets of creating fire-adapted communities (Calkin et al. 2014). While this body of work reveals important behavioral aspects of the wildfire dilemma, resting within the hazards/disaster framework may truncate the scope of research and thereby limit opportunities for more comprehensive consideration of the intersections of the systems at work.

Community case studies address this limitation, in part, by highlighting the importance of examining this intersection by placing hazard coping behaviors within local contexts to provide insights into how contextual characteristics and local histories shape response to wildfire risk (McCaffrey et al. 2013, McCaffrey 2015). Such efforts build understandings of the function of local social systems but often face limitations in comparability across context due to the scale of inquiry. In this vein, some research has prioritized investigations to characterize at-risk communities and interactions in the local context (Paveglio et al. 2015, 2016) in

order to further understand social systems that face wildfire. Relatedly, recent efforts seek to characterize local capacity to adapt to changing conditions (Paveglio et al. 2012). Other efforts have sought to illuminate the role of governance in adaptation (Abrams et al. 2015). Together, these efforts contribute to an expanded approach within wildfire social science inquiry to consider how fire adaptation may function in the varied social systems affected by and responding to wildfire. While this research contributes to an expanded understanding of social response to wildfire, it consistently relies on existing definitions and framings of fire adaptation found in wildfire policy and associated formal wildfire management communications. In other words, to date, research has yet to explore how adaptation in the wildfire context is understood by the stakeholders who comprise the relevant social system(s). Studies neglect to critically grapple with what it means for various stakeholders who comprise the social component of social-ecological systems to adapt to wildfire. At this junction, it is unclear how fire adaptation is understood beyond the stakeholders who are engaged in the formal reframing of wildfire adaptation policy and programs. Importantly, recent work argues that agencies engaged in management at the intersection of natural resources, hazards and disasters, and climate change may need "clear definitions and applications" in order to forge a path forward (Bone et al. 2015).

Solutions to this dilemma, including a shift toward "fire adaptation" and "fire-adapted communities," suggest opportunities for paradigmatic shifts in how wildland fire is understood and managed (Olson et al. 2015, Schoennagel et al. 2017). The power to sculpt narratives is not shared evenly across society, and some stakeholders have more power and opportunity to engage in processes by which a societal problem and its solutions are defined and set in motion (Spector and Kitsuse 1987). Stakeholders from key organizations, such as the participants who contributed to the construction of the National Cohesive Strategy (2011), are examples of critical stakeholders who engage in processes that frame and construct hazards for society to address (Dietz et al. 1989, Gamson and Modigliani 1989, Cvetkovich and Earle 1992, Clarke and Short 1993, Stallings 1995, Simpson 1996). From earthquakes to wildfire, stakeholders play a critical role in deploying power to define and control the framing of understandings of hazards, disasters, the environment, natural resource dilemmas (Greider and Garkovich 1994, Stallings 1995, Brenkert-Smith 2008), and now, fire adaptation.

Definitions from formal wildfire adaptation efforts indicate that fire adaptation requires multiscale and multisectoral action to successfully shift from a fire suppression paradigm that seeks to control nature to one that supports wildfire adaptation. If policy narratives and related programmatic activities are shifting to wildfire adaptation, it becomes important to understand how other stakeholders who comprise relevant social systems define and understand what it means to adapt. Further, it remains critical to address how previous efforts to foster risk mitigation and response, which have comprised the central tenets of engaging communities at risk, fit in relation to the new paradigm. Indeed, shedding light on the extent to which understanding of fire adaptation is shared across relevant stakeholders constitutes a critical line of inquiry if fire adaptation is to become a central piece of managing the wildfire social-ecological system.

METHODS

Approach and overview

Creating fire-adapted communities requires efforts beyond the development of policy and programs. Adaptation in fire-prone communities requires development of insights into what adaptation means to communities at risk, what it means for communities to adapt to fire, how one might recognize a community is fire adapted or on the path toward adaptation, and what kinds of social processes support such efforts. To develop these insights, we conducted indepth interviews that examined conceptual notions of fire adaptation across stakeholders who were engaged in wildfire activities. This effort was guided by a constructing social problems approach, which maintains that the ways in which society defines and articulates a social problem, as well as the solutions to that problem, are the product of social processes (Spector and Kitsuse 1987). As such, interviews were designed to shed light on how fire adaptation is understood and described by individuals who were engaged in wildfire risk reduction efforts at three levels: as community leaders and as regional leaders in southwest Colorado, and as national leaders in formal fire adaptation efforts.

The qualitative research we describe is part of a larger research endeavor that assumes the qualities that characterize fire adaptation manifest as emergent properties of social processes at programmatic, community, and household levels in the form of measurable indicators or characteristics. The larger project includes a collaborative data collection and analysis effort using paired household and parcel data to better understand the influence of these social processes across a diverse set of communities (Meldrum et al., *unpublished manuscript*).

A central goal of the interviews was to gain insight into how individuals whose work focuses on reducing risk to the social components of the wildfire social-ecological system understand the concept of fire adaptation. The interview guide was designed to allow participants to describe how they characterize the fire adaptation, the goals of adaptation, the capacity to adapt, and the process of moving toward adaptive response to wildfire risk. This broad approach was used to encourage participants to reveal their perspectives on adaptation, and, if relevant, how it pertains to how they undertake their wildfire-related work.

As is common in qualitative research endeavors, the questions that shape interview guides do not seek to address specific hypotheses, but rather are intended to ensure that all participants are encouraged to discuss key areas of inquiry. Analysis of data from across the interviews informs the development of key themes and their presentation. Analysis of these data revealed three key themes: (1) participants across stakeholder groups revealed shared understandings of fire adaptation as a way of living with wildfire, with several common key attributes, including the ongoing nature of adaptation, (2) participants articulated a range of challenges associated with translating the concept of adaptation into practice, and (3) participants' thinking about adaptation efforts is situated within the scale of their programmatic scope. These findings are described in the *Results*.

Study context

Interviews were conducted with stakeholders who were engaged in wildfire management on three scales: national, regional, and

local. While the national-level participants were not location-specific in their efforts, the regional and local participants worked in southwest Colorado. The regional and local participants led wildfire risk reduction activities in 11 county areas in southwestern Colorado and represented two multicounty nonprofit wildfire organizations: West Region Wildfire Council (WRWC) and FireWise of Southwest Colorado (FSC).^[2] West Region Wildfire Council is a collaborative effort "to mitigate loss due to wildfire in wildland urban communities while fostering interagency regional partnerships to help prepare counties, fire protection districts, communities and agencies to plan for and mitigate potential threats from wildfire" in six western Colorado counties (<http://www.cowildfire.org>). FireWise of Southwest Colorado serves five southwest Colorado counties and seeks to engage at-risk communities through outreach and education, planning efforts, and implementation of fire mitigation activities. West Region Wildfire Council and FSC serve a broad area that varies widely in regard to socioeconomic and ecological characteristics and community size and type. One characteristic that is broadly shared, however, is that the region is characterized as having high wildfire risk and dispersed response resources.

Data collection

Indepth interviews were conducted with 25 purposively selected participants who represented the three stakeholder scales. Purposive sampling of interview participants is a nonprobability technique in qualitative research (LeCompte and Preissle 1993, Patton 2002) that seeks to select participants who have the types of information, expertise, and experience that directly relate to the research endeavor. In this case, participants were selected based on the roles they played in efforts that seek to reduce societal risks associated with wildfire; moreover, their involvement with, and proximity to, formal fire adaptation was situated on a continuum. This continuum ranged from those who played key roles in articulating and promoting fire adaptation at a national level to those who were engaged with community members within their own neighborhoods or fire districts.

The first group was comprised of individuals ($n = 8$) who were actively engaged in national-level leadership efforts with the Fire Adapted Communities (FAC) Coalition and were identified through their formal affiliation with FAC. These individuals contribute to the development of the programmatic dimensions of efforts that support and promote fire adaptation in at-risk communities. In addition to being members of the Fire Adapted Communities Coalition and FAC Learning Network, the participants in this group also represented a range of institutions (from federal agencies to community organizations) for which supporting fire adaptation is a goal. Agencies represented by study participants included the North American Fire Learning Network, the International Association of Fire Chiefs, the Watershed Research and Training Center, The Nature Conservancy, the Institute for Business and Home Safety, the U. S. Forest Service, and the National Fire Protection Agency. In other words, these participants were formally linked to large, federal agencies and NGOs that articulate and create programs to carry out policy trajectories in a range of different wildfire-related sectors.

The second group was comprised of individuals ($n = 6$) who played a role in regional leadership through their positions with one of

two regional organizations that seek to reduce wildfire risk in western Colorado: WRWC and FSC. These regional organizations were selected because they both have a history of working on wildfire issues and experience with fire adaptation efforts. However, the two organizations differ in their histories and in many of the specific approaches and programs they offer. Both organizations are part of a larger research effort. The participants were identified based on the key programmatic roles they played in developing and implementing wildfire education and outreach programs and engaging in and supporting wildfire risk reduction activities.

The third group was comprised of individuals ($n = 10$) who played a role in community leadership in the areas served by the regional organizations. The WRWC participants included fire chiefs or assistant chiefs who supported and liaised with the council to promote risk reduction within their protection districts. The FSC participants included neighborhood ambassadors who focused on education and outreach efforts to promote risk reduction activities within their communities. This group of participants engaged with community members most closely; they were members of the communities in which they worked, and sat at the intersection of programmatic efforts developed at the national, regional, and local levels and the communities targeted for education efforts, wildfire mitigation cost-sharing opportunities, and other efforts that seek to reduce risk and increase the capacity to adapt and resilience. These participants were purposively selected from lists of local leaders that were provided by WRWC and FSC based on the types of communities and fire districts in order to ensure that a variety of contexts was represented.

Inperson interviews were conducted whenever possible ($n = 18$), and over the phone ($n = 7$), as needed. All interviews were conducted by the same researcher and were guided by the one interview protocol to ensure that each interview covered the major topic areas and to increase comparability across interviews. All interviews were recorded and contextual notes were taken during the interview.^[3]

Analysis

Digital audio recordings from each interview were transcribed and then coded by a single coder using standard qualitative methods (Gibson and Brown 2009). An initial coding scheme was developed based on the broad areas of inquiry outlined in the interview guide. The coding scheme was expanded based on nuances and dimensions of the broad areas of inquiry through an iterative coding process (Lofland and Lofland 1995, Strauss and Corbin 1998, Auerbach and Silverstein 2003).

The primary goal of coding was to identify the qualities of fire adaptedness the study participants articulated. Codes that appeared frequently across narratives indicated the possibility of shared understanding. As such, coded text was used to develop summary descriptions of areas of confluence and difference in participants' characterization of fire adaptation. Key themes and subthemes within the data were identified through iterative coding processes and were explored to understand how codes related to one another, which revealed linkages between themes (Ryan and Bernard 2003, Gibson and Brown 2009), and were informed by adaptation, resilience, and wildfire social science research literatures as well as research team discussions.

The findings we present represent the key themes from the data. Illustrative quotes are included in cases when the participant articulated a theme that was shared by multiple participants and did so in a particularly useful way for the presentation of the data (Boyatzis 1998). Quotes were edited only for ease of reading, never for meaning, and any omissions are noted with ellipses.

RESULTS

Across participants, fire adaptation was described in multiple interrelated ways. Most descriptions focused on broad, overarching, or conceptual descriptions of fire adaptation, using a variety of terms, including fire adaptation, adaptedness, and adaptiveness, often interchangeably. Commonalities in these descriptions rested with fire adaptation as an ongoing, context-specific effort to "live with" wildfire. Though descriptions of what it means to "live with wildfire" constituted variations on a theme, the theme of "living with wildfire" was consistent. These broad descriptions invoked language that indicated the importance of considering the ways in which social and ecological systems interact.

I think of adaptation as behavioral and structural changes or modifications that entire communities can be doing. That could be buildings, roadways, landscapes, vegetation, then, also human behavior. All of those changes that are meant to bring us a more able [sic] and more resilient...more able to deal with wildfire, is another way of saying it. More resilient to that possibility. For me, that could mean changes to building codes. It could mean people's understanding of the ecosystem that they live in and the history of fire occurrence in that ecosystem. It could mean a whole bunch of things related to how we live in the world that we do. (Regional leadership R5)

Beyond such overarching characterizations, participants' narratives revealed several key themes of note. First, narratives contributed to the identification of a small number of essential attributes of adaptation, including the notion that efforts must be ongoing to constitute being adaptive. Second, narratives revealed challenges associated with translating the concept of adaptation for implementation due to the varied contexts within which fire adaptation may be needed. Third, while most participants considered the term "adaptation" to be useful, participants offered varied accounts of its applicability. This highlights important opportunities for coproductive processes that might ameliorate concerns among some participants of the term coming from the top-down. And finally, participant stakeholders revealed the importance of engaging scale as a tool to facilitate approaches to, and engagement with, fire adaptation.

Essential attributes of adaptation

When asked about the characteristics of a fire-adapted community and whether there are key attributes, participants tended to describe attributes for which direct metrics may not exist or may be difficult to measure. The two key attributes described by all participants were consistently intertwined: "awareness" of wildfire hazards and "acceptance of responsibility" among residents living in fire-prone communities.

Community leader C5: "Also, one of the key components of it [adaptation] is the acceptance of responsibility..."

Interviewer: “Responsibility for what?”

Community leader C5: “For where you live and the ecosystem that you’re living in. Acceptance of the fact that individual people or entire societies may not be bigger than the ecosystem.”

It is notable that much of the hazards research on wildfire includes efforts to assess stakeholders’ awareness of wildfire risk, particularly among those living in fire-prone communities (e.g., McGee and Russell 2003, Jarrett et al. 2009, Bihari and Ryan 2012, Brenkert-Smith et al. 2013). While awareness of the wildfire hazard and acceptance of responsibility were discussed conceptually, it was consistently noted that such characteristics must translate into observable outcomes in terms of household and/or collective community efforts to change the conditions of the community in ways that reduce risk. Observable outcomes that were mentioned included the development and implementation of preparedness efforts (e.g., evacuation planning, improving egress), the implementation of mitigation efforts (e.g., vegetative fuels and structural improvements), and efforts to support response (e.g., roadside treatments, improving access and signage). In other words, awareness of the wildfire hazard and acceptance of responsibility were seen as indicators of a resident’s or community’s understanding of its role in a fire-prone landscape but is observed through its actions in response to that role. That is, “awareness” and “acceptance” as used by participants, entail related actions, thus extending beyond the literal meanings of the terms. Thus, while participants varied in the extent to which they described these as distinct attributes or necessary precursors to adaptation, they consistently asserted that action served as evidence of awareness and acceptance.

I think the bigger piece is that if a community takes action to prepare itself, it can live successfully with fire on the landscape on a regular basis, without loss of life, property, or the need for an extensive protection effort. (National leadership N5)

Other attributes that were described as essential to, and in support of, adaptation included what could be characterized as adaptive capacity (Pavegelio et al. 2015). Adaptive capacity can include the presence of local leadership across sectors as well as leadership directly related to wildfire issues. It can also include other capacities that are described as critical to fire adaptation, such as social capital, including knowledge and networks. These examples of social capital are not unlike those that are understood to be critical in the face of climate change adaptation (Adger 2000), which include having to be continually engaged in efforts such as group activities, trainings, and communication skill building. Indeed, participants consistently discussed adaptation as processes that arose out of local resources and capacities and resulted in overall reduction in risk. It is fair to say that participants generally understood a fire-adapted community as one that:

...has taken on a holistic approach to dealing with the fact that they live in a fire-prone area. By dealing with that, it means that instead of having the concept that the fire department will save me, or it’s not going to happen to me, or if my home burns that’s what insurance is for, they have taken an active role in understanding that, yes,

they are at risk to wildfire, mitigating that wildfire risk to the point that hopefully, which is what we all hope for, if a fire were to move through that area there would be less devastation and catastrophic loss. (Regional leadership R4)

A central, long-term goal associated with attaining the attributes described was the possibility of communities surviving fire, and in some cases, even the use of fire as a fuel management tool. The term “survivability” arose numerous times and was frequently used interchangeably with fire adaptation. In these instances, survivability was used to indicate that a community would “survive” a wildfire event with minimal damage, though the extent to which fire suppression resources were a part of the picture varied.

Ideally, my vision would be that, if the community was well-enough prepared, and there was fire on adjoining lands, that that fire could actually be allowed to move into that community without it being a big threat. In an ideal world. In the right type of landscape. (Regional leadership R2)

Most participants acknowledged that fire suppression would likely continue to play an important role in the WUI, and that in some communities, wildfire events would always require suppression resources due to biophysical features, including terrain, topography, and the existence of fuels that would remain beyond the community’s capacity to change due to the mosaic of property ownership.

Ever-onward, Adaptation

A key aspect of participants’ characterizations of fire adaptation included the importance of understanding that the work of adaptation is ongoing. Due to the continuous requirements related to vegetative fuel management (and social changes due to residents moving in and out of communities), fire adaptation was characterized as a dynamic process:

I think that having people that understand that they have an issue, people that are proactive in preparing their community and educating their community and people that recognize that there is no checkbox. In a fire-adapted community, it’s a constantly evolving cycle that never ends. There’s no sign to put out in the front. ...If it’s one thing that I’ll joke about, about Firewise, is, ‘Oh great, we’ve rented a chipper, once a year, and we can put a sign out front.’ The sign doesn’t do anything for you, folks. There is no sign in fire adaptability, because it’s a constantly evolving process and if you can get a community that recognizes the need, that’s proactive to do the work and recognizes that it never ends, then that’s, to me, some of the biggest attributes. (National leadership N7)

As such, adaptation was described as a process that does not have an endpoint but rather is ongoing. At the smallest of scales, this simply meant that homeowners must continue to reduce fuels at the parcel level or expand efforts to the community-level. At the more expansive scales, this meant that efforts must continue to include more sectors, more stakeholders, and broader landscapes. Leadership was deemed imperative for sustained, coordinated

efforts, particularly in light of concerns about potential declines in awareness and acceptance of responsibility during seasons and/or years with lower wildfire risk.

The game is not going to be over when you treat all this [land for fuel reduction]. You're not going to get to treat all that before the game changes enough that you have to rethink what you actually need to do to have resilient communities, resilient landscapes and those kinds of goals. (National leadership N1)

For some participants, these discussions included the term “resilience.” For participants who engaged the concept, the use of the term was inextricably linked to the language of fire adaptation, as in “a fire-adapted community is resilient to wildfire.”

We define fire adaptedness as the community's ability to be resilient before, during, and after fire. That resilience is somewhat beyond just the fire part, because it involves them being engaged in caring for people in place and figuring out how to live better with fire and fire environments. (National leadership N1)

Interestingly, when asked to define what “resilience” means in the context of the discussion of fire adaptation, the general explanation was that resilience is interchangeable with the goals and general concept of “adaptation.”

Whatever those characteristics are of a resilient community would apply for a fire adaptive community in my mind. Then a focus [is] not just on mitigation and preparation but also on, we say before, during and after a fire. You taking action at all those points and learning as you go and taking note of changing circumstances and adjusting, so a continuous adaptive management is really the cycle. (National leadership N8)

Conceptualized this way, adaptations and adaptive action at various levels of the social system and at critical intersections of society and the environment would help achieve increased resilience before and after major events. As such, resilience is a characteristic of a part of the social system that is, and continues to undertake, adaptive actions.

Translation from the concept of adaptation to communities, programs, and management

In order to better understand how participants' concepts of adaptation might manifest, respondents were asked to describe communities that exhibit characteristics of fire adaptation or may be on the path toward fire adaptation. Overall, communities identified and described in the interviews reflected participants' assertions that fire-adapted communities are those that “are educated and aware” and “take responsibility.” Not surprisingly, how those central characteristics manifested varied depending on the biophysical and social landscape of the community.

Community leaders' descriptions of their communities' efforts varied widely. Some community leaders identified nascent stages such as simply identifying specific steps they might take, such as a community meeting or mailing an informational flyer. And most participants reported ongoing efforts and struggles to rally community members to engage and the obstacles they face. The ongoing nature of these efforts echo the sentiment that adaptation

is ever-onward. In contrast, a few participants made assertions that their community had accomplished everything needed to be considered fire adapted.

We have adapted to living in the forest. We've mitigated around our homes, all around our buildings, our barns, things like that so that even if a fire does come through we have great separation between the trees that are near our home and we are not...I don't think any of us who have homes here now are actually thinking that a fire would come through and take our homes...We've adapted to living in the forest to where if a natural fire occurs, which happens all the time, we get single fire lightning strikes, single tree lightning strikes and they catch on fire. The fire department comes and puts them out...I now go on vacations in July and August, where I never used to because I was always afraid of wildfire. We've adapted our properties to where we no longer worry about catastrophic fires taking out our homes. (Community leadership C6)

Participants working at the regional level were most capable of identifying and describing multiple communities at various stages of a process that would fit into the definitions of adaptation that participants described. These participants were able to note the wide variation in communities' willingness to engage the topic, awareness of stages of adaptation, local capacity existing and/or being mobilized, the existence of leadership, and in some cases, a history of ongoing efforts that have measurably changed landscape characteristics and resident practices. These participants were quick to note that it is in the variation across communities that challenges arise in developing and implementing programmatic approaches such that they attend to this variation. Such approaches must be scalable and nimble enough to step forward based on community characteristics when opportunities to do so are created or presented.

Importantly, participants' attention to variation in manifestations of adaptation across community contexts was articulated by most of the study respondents and echoed research that demonstrates the importance and diversity of community characteristics (McCaffrey 2015, Paveglio et al. 2015, Meldrum et al., *unpublished manuscript*). Further, most participants discussed the fact that scaling up beyond the household level entails processes that involve more stakeholders and that the interdependency among sectors increases—both facilitating and necessitating engagement with more stakeholders. Notably, however, according to participants' narratives, it appears that activities related to wildfire still rest largely within the traditional hazard mitigation/disaster preparedness framework, with the focus remaining on efforts to prepare, mitigate, or respond to sources of risk. In contrast, discussion of efforts to make more fundamental changes to the wildfire SES remained largely at the conceptual level.

Position and proximity to naming power: What's in a name?

For many participants, particularly those working at the national level, the concept of, and related efforts to promote, “fire adaptation” constitute the timely arrival of an effective and intuitive umbrella term that brings together many aspects of the wildfire dilemma. For those participants, the perceived intuitive nature of the term was thought to help facilitate the integration of various sectors that have long been at work on wildfire issues,

including entities that promote risk reduction, land management, and fire suppression resources.

The language of adaptation and resilience were also described to serve another purpose: to indicate a differentiation from previous efforts and to highlight a focus on the ongoing and cross-sectoral nature of adaptation efforts.

In order to change the game and have people live better with fire and fire environments, you have to take a more fuzzy-boundary or -level approach and really integrate not just being resilient before, during and after a fire, but you have to engage them in all aspects of the Cohesive Strategy. Not just the Fire Adapted Communities component, but learning to be in support and take actions around resilient landscapes and also around response to wildfires. (National Leadership N1)

This “fuzzy boundary” approach was thought to serve as a way to help signal a change in approach that separates current fire adaptation efforts from other formal efforts that may include a certification process (e.g., Firewise USA Communities). By changing the language, national leadership participants sought to clarify that the work of adaptation included many of the goals of previous fire risk reduction efforts but also pursues broader efforts.

Most participants who were not part of the national leadership, however, asserted that “fire adaptation” is simply a new phrase or term for a set of goals that have long been the agenda of agencies and programs all along. The new term was not seen as evidence of a paradigmatic shift in the approach to wildfire, but rather a potentially appealing repackaging. Participants presented this repackaging with varied levels of skepticism. For the least skeptical, adaptation maintains the primary agenda but expands risk reduction from parcel-level efforts to community-level efforts, integrates fuel reduction on adjacent public lands with community efforts, and seeks to shift funding to mitigation as a way or reducing suppression costs.

What we're doing hasn't changed all that much, because [the organization was] really doing, what I would consider adapted community stuff from before I was involved. We've started using that terminology. To some extent. Not as much with [or] on a one-on-one basis with homeowners, as using it in a community setting. (Regional leadership R1)

For others, however, the use of “fire adaptation” or degree of “adaptedness” was described as a type of shell game, in which the repackaging of risk reduction efforts was distracting and constituted simply another term to understand, communicate, and incorporate into existing efforts. Importantly, all those who indicated frustrations with adaptation as a shell game were able to provide a definition of fire adaptation that was very much in line with the shared understanding of the other respondents and with the working definition being used by formal outlets, including the Fire Adapted Communities Coalition and the Fire Adapted Communities Learning Network. In other words, concerns about a shell game were not fueled by a lack of understanding of the intended meaning of the term. Rather, it appears that the frustration was fueled by skepticism regarding the applicability of the new term to their wildfire work.

Yes, I guess. I think the word 'adapt' is just a strange word when it comes to wildfire and living within a region where that wildfire risk is prevalent. Not to sound rude [but] the bottom line is that if people want to live within that environment, they need to take steps to protect themselves and their property because the risk of wildfire is there. I think that over the last 30 years, what those steps are have been clearly relayed, whether it's from the federal government, whether it's from state forest service, from wildfire experts. The information is there for people to mitigate around their homes and their property, and to come up with adequate planning in the event of a wildfire as to what needs to take place. I guess if that's the definition of adapting to wildfire, then that makes sense. (Community leadership C10)

In other words, it appears that the term is intuitive regardless of how skeptical participants were about changes to the packaging of community wildfire risk reduction efforts into the terminology of “fire adaptation.” Indeed, skeptics largely articulated a definition that was consistent with those articulated by the most ardent advocates of the term.

Important to this discussion, however, is evidence that those who were skeptical of the term differed from advocates of the term on the application and utility of the concept of fire adaptation as it related to the domain of their wildfire work. Those differences were particularly highlighted as the issue of checklists emerged. Participants from national and regional leadership, who were tied to formal efforts to promote the concept and practice of fire adaptation, clearly and consistently asserted that efforts toward community adaptation must proceed with the tenet of a no-checklist approach. This central tenet of formal fire adaptation efforts was described as one of the unique innovations associated with the conceptual and programmatic aspects of formal adaptation efforts. The justification for this tenet is tied to a definition of adaptation that maintains that adaptation is a process that is determined by the unique aspects of the context in question.

In contrast, participants from local leadership who work at the most local level—fire chiefs and neighborhood ambassadors—reported finding great value in checklists. For these participants, checklists or other methods of marking metrics achieved provide a way of identifying specific actions that may be appropriate to pursue and support, opportunities to gauge progress, and opportunities to consider actions that were not intuitively considered relevant by a community or property owner.

Right now, in fact, we had this discussion last month... 'This is fire-adapted community,' and I said, 'You know what? This is a bunch of mush. Give me concrete steps that I can take,' because they talk about, 'We'll deal with your schools and deal with industry.' Well, I don't have schools. I don't have industry. I have homeowners' associations and a fire department and they're doing great things, but to say that we're fire adapted is tough for us. ...It's also kind of tough for me because I'm more of 'Okay, do these things and you will become a Firewise Community.' [But with fire adaptation] there's no checklist on what things to do to help improve. (Community leadership C9)

The checklist, therefore, is a double-edged sword: the benefit is that checklists specify important tasks that provide concrete steps for local leaders and may enable capacity in the form of direction. The other side is two-fold: first, items on checklists were described by participants at the national and regional levels as problematic due to the impossibility of developing a checklist that is applicable to all contexts. This concern reflects experience-based insights that suggest that how a community may adapt is context-dependent and reflects conclusions asserted in the wildfire research literature. Second, many participants described a potential shortcoming of checklists as the concern that users may see a discrete set of tasks and assume they have “adapted” upon completion, which would be counter to the key shared understanding of adaptation which maintains that efforts must be ongoing. As such, checklists demonstrate the tension between developing a broad concept intended to shift wildfire understandings and the process by which such concepts translate into action at different scales.

The challenges associated with translating the concept of adaptation to communities, programs, and management shine light on the stakeholders at the national level, who hold more power in the processes through which what it means to adapt to wildfire is named and characterized. Likewise, the narratives of skepticism among those working at the local level who may prefer to proceed with a checklist in hand shine light on the challenges associated with translating the concept to programs and management within at-risk communities. This is not to suggest that opportunities to engage in coproductive processes (Maiello et al. 2013, Clark et al. 2016) related to wildfire adaptation are not available. Rather, it appears that study participants were not evenly aware of such opportunities, and their perspectives may provide important insights that may contribute to the processes by which fire adaptation is understood and pursued.

Scale as a tool to facilitate thinking about a continuum of adaptation efforts (and assessment)

The point at which study participants described adaptation, on a spectrum from conceptual to applied, appears to reflect their relative position with respect to formal adaptation efforts. When participants were asked to describe what adaptation looks like, the focus of their narratives highlighted the ways in which their own work intersected with the continuum of efforts through which the wildfire dilemma is addressed. As such, those more detailed discussions ranged accordingly. At the smaller scale, discussions with local leaders tended to focus on the role of being a resident in a fire-prone community or on community leaders' expectations of how a community understands and responds to wildfire. Activities at this scale focused on risk reduction at the parcel scale or shared activities within a community. As such, such activities might be characterized as traditional hazard mitigation activities. Moving up the social scale, community and regional leaders tended to engage in discussions focused on engaging community members and on the design and implementation of programs that are intended to reduce wildfire risk. Activities at this scale focused on building opportunities for community engagement and initiating activities across sectors. Such activities were noted as requiring coordination and leadership. At the upper end of the scale, a focus on fleshing out the conceptual dimensions of fire adaptation and building programs to support the pursuit of fire adaptation across sectors and leveraging activities among

programs rested primarily among those engaged in the national leadership. What is notable here is not inconsistencies in understandings, but rather the continuum upon which the study participants are engaging in wildfire activities. Critical to this is evidence of overlap across social scale that indicates the potential of further strengthening the interconnectedness of scales.

Participants from the national leadership who work at programmatic and policy levels were more likely than other participants to articulate broad conceptual characterizations of adaptation and the interconnectedness of sectors required for landscape-level fire adaptation in the social and ecological systems. These participants' conceptualization of adaptation operates at a higher, or more collective, social scale. At this higher social scale, efforts entail more partners, and represent a wide array of stakeholders, collective action, and the implicit incorporation of risk interdependency considerations. The focus on a higher social scale, at least conceptually, facilitates the harnessing of broader resources to contribute to fire adaptation beyond what an ad hoc household-by-household approach might yield.

For those who were working either with the regional programs or at the community levels, adaptation was more likely to be described at the community level. For most of those participants, the notion of “community” was intuitive, though flexible, with participants asserting that the scale of what constitutes a community flexes with the local context. Variation in community type and the broader regulatory environment were noted by many as key factors that influenced the ways in which those participants sought to pursue their work. For example, in communities in which obstacles to addressing community-level efforts existed (e.g., a disengaged fire department, home owner association restrictions on tree cutting, or community resistance to regulatory efforts such as building codes), participants described reliance on established, household-level risk mitigation and preparedness messages as critical pieces of their efforts. Not surprisingly, community meetings were described as opportunities to move the presentation of risk mitigation from household-level activities toward the consideration of collective action on sources of shared risk (e.g., roadsides, egress). This level of engagement was described as potentially productive in both formal and informal communities and as having the potential to create opportunities for engagement regardless of the heterogeneity of the community (i.e., not everyone is on board, but can work with anyone who is).

National and regional participants generally acknowledged that the fire-adapted community concept could scale up to “communities” beyond a typical “neighborhood” scale to a broader, regional, or even landscape level. As such, it appears that one of the benefits of focusing on “community” is that it remains a flexible term and concept, and this flexibility provides opportunities to imagine (and indeed, act) on wildfire issues beyond the individual parcel level. Notably, for several participants, however, the notion of “community” presents significant challenges because the landscape of their area does not necessarily fall into neat or definable communities. This was particularly noted in the WRWC area by both regional and local leaders, but was echoed in the FSC study area as well. Those participants engage in efforts that provide leadership and resources to a wide range of communities and community types. In all likelihood, the difficulty with the term reflects the complexity

of the social landscape and takes into account the fact that those participants also seek to engage residents who do not necessarily reside in a social grouping that they might consider or call a community.

The range of the scale discussed by participants reflects important questions regarding the scale at which adaptation can be undertaken and indeed assessed. It appears that the primary determinant of the focus of participants' narratives reflects the relative positions study participants occupied in relation to fire adaptation activities. Indeed, while the literature suggests that adaptation can be understood as "the enactment of context-specific processes and actions local people undertake in the face of wildfire risk" (Paveglio et al. 2016), we see that "context-specific" is determined in part by the scale at which the dilemma is addressed.

DISCUSSION

Notions of how to live with or co-exist with wildfire have emerged, in part, as escalating suppression costs, wildland fire disasters, and indirect ecosystem losses reveal the unsustainability of the existing fire management regime. Indeed, what constitutes a sustainable approach to any natural resource or hazard management dilemma is historically contingent because the conditions of any SES change over time. Often the cumulative impacts of a management approach reflect a trajectory put in place years or even decades ago. While unintended consequences of the fire suppression paradigm have been known in the scientific community for decades, practices that shift or support a shift to reduce such adverse effects have been slow to take root. Current efforts to support fire adaptation at the national level, however, reflect shifts toward a new fire management paradigm. Such change comes with shifts in the framing of, and narratives about, the wildfire problem that set in motion efforts to address a new understanding of that problem. The interviews in this study offer insight into how stakeholders engaged in wildfire risk reduction at three levels of action understand what it means to adapt to wildfire. As such, they shed light on how the concept is framed and understood among stakeholders who are at work sculpting national-level policy and programs, as well as among those whose wildfire work rests at regional and community levels. We see the importance of the role of scale as well as the interconnectedness of scales and sectors.

Between a checklist and an idea: the role of scale

The concept of adaptation and support for the development of fire-adapted communities is increasingly a part of the language and programmatic efforts emerging from major stakeholders in the wildfire management dilemma. Interviews with national-level participants in this study who represented major agencies across multiple sectors at work in the wildfire dilemma articulated and embraced a relatively consistent understanding of the concept of adaptation. Importantly, those participants appeared to identify adaptation as an important mechanism that may support a paradigmatic shift in the management of wildfire. Indeed, at the conceptual level, adaptation appears to provide a way to pull together and bridge multiple sectors at work at multiple scales in the wildfire dilemma. Whether or not the concept is similarly meaningful at the levels of the regional and community leadership included in this study is a critical question, as such stakeholders could play important roles in the transition of language, public

understandings, and programs needed to support such efforts. Shared understanding of, and investment in, the notion of adaptation across stakeholder groups is particularly important because, as adaptation is described here, efforts require the active involvement of stakeholders at multiple social scales. Indeed, at its very core, adaptation is described to rely upon the interconnectedness of sectors at work to address the unintended consequences of past approaches in order to lay out a path that rights those missteps and seeks a more sustainable future.

And yet, it appears that gaps exist between the efforts to characterize, define, and set programs in place to support adaptation and the stakeholders who focus on the spaces onto which adaptive practices are to be implemented. These gaps seem to reflect where study respondents sit in relation to the scope of the mandates and responsibilities of their positions. Importantly, however, data from those interviews do not indicate that these gaps are insurmountable, but rather that these gaps, if identified and addressed, may be seen as opportunities.

Certainly, such opportunities are evident in participant narratives, which suggests that different communities may take different paths to adapting to wildfire in the context of a societal paradigmatic shift in how wildfire is approached. Mixed pathways are needed because many pathways are predicted to arise in response to various scenarios, including collapse, business as usual, or via an optimistic harmonious approach (Olson and Bengtson 2015), that may exist across the landscape simultaneously. Some communities will always need suppression, and even with suppression, wildfire-related losses will never be eliminated. Some communities will adapt proactively, just as we already see some communities engaged in work that reduces risk and increases resilience. Like adaptation research related to climate change, we see that participants largely share the view that adaptation must occur based on local experience and contextual knowledge (Vedwan and Rhaodes 2001, Thomas et al. 2007, Adger et al. 2009). Indeed, this tenet was articulated by all participants. And yet, we also see that participants who are a part of community leadership, those most keenly aware of these contextual characteristics and differences, are the most likely to place value on tools (i.e., checklists) to help translate the concept of adaptation to specific, measurable, and locally relevant community goals. What is perhaps lost when regional or national leaders object to indications that checklists are valuable to the work of local leadership is the importance of the contributions of local leadership in identifying and articulating local capacity and the need to engage in adaptation efforts. Processes that can engage this tension can facilitate adaptive thinking or planning and build local capacities needed for ongoing adaptation efforts. In other words, the promotion of the concept of adaptation, when bolstered by support of local processes that translate the conceptual to the practical, may imbue the applied with local knowledge and contextual nuance and serve to bridge conceptual to implementation, national to regional to local leadership, and spur action at multiple social scales.

Interconnectedness of scales and sectors

Participants' descriptions of their wildfire risk reduction efforts highlight the ways in which their work, when considered collectively, spans the range of sectors and continuum of social scales at which adaptation or adaptive actions are required.

Participants represented a range of sectors that are relevant to creating fire-adapted communities and landscapes, from WUI communities to private industry to federal agencies. The participants from leadership at the regional and national levels did well in highlighting the importance of engaging multiple sectors. And while participants were largely able to identify and articulate the varied roles different sectors play in the shift toward fire adaptation, barriers remain in bridging these sectors. Fire suppression approaches can be modified only with the right fuel conditions, which requires engagement and coordination with land and natural resource management, and with communities in the path of wildfire. However, the barriers to coordination are not insignificant, particularly for those at work on the ground. Importantly, the interconnectedness of sectors appears to be harder for those at the community leadership level to conceptualize. This may be partly because accessing representatives of the multiple interconnected sectors required for landscape-level fire adaptation requires social, economic, and political capital that is unevenly distributed across communities and their leadership.

Efforts that connect across scales, from the most local efforts to regional or national efforts, may galvanize opportunities to coordinate. Moreover, efforts that link scales may also contribute to bridging the kinds of activities needed to reduce risk in the wildfire SES. Bridging risk reduction activities from mitigation actions taken at household or community levels to engagement in local or regional regulations related development in the WUI to coordination of fuel treatments or fire suppression strategies would contribute to shifting from a “control of nature” approach to one that supports “living with wildfire.”

CONCLUSIONS

As with any qualitative study, there are limitations to the extent to which our findings and conclusions apply beyond the study area. While this study engaged participants whose roles operated at the national level, the regional and community leaders were from southwest Colorado. It is likely that there are contextual factors at play in this area that may differ from other fire-prone areas. Given that caveat, our work sheds light on social processes that will interact with broader shifts underway in the conceptualization and approach to wildfire in the United States. While adaptation is a broad concept, we found that characterizations of fire adaptation were largely consistent, with variation that appeared to be related primarily to the loci of focus of participants’ wildfire-related efforts. Overall, the stakeholders in this study, who represented leadership at the national, regional, and community levels, described an inevitability of wildfire on the landscape and the need for communities to address conditions that reduce losses and increase the likelihood of survivability. Importantly, while participants characterized several pathways, capacities, and/or efforts that are critical to supporting this undertaking, the efforts were described as requiring awareness and responsibility, leadership, and the capacity to flex as the context requires.

Critical to this study is the revelation that while all participants described adaptation in relatively consistent ways at the conceptual level, the translation of the concept to communities and programs presents challenges. Participants’ perspectives were shaped largely by the social scale at which their efforts contribute

to the management of the wildfire dilemma. National leadership approached adaptation primarily at a conceptual level and described its application in broad ways that included reducing adverse effects from wildfire for the benefit of society. Local leadership approached adaptation primarily as a concept that had varied applicability to their efforts. For some, it was an intuitive concept under which their existing efforts neatly fell, but for others, it was described as a concept developed to push an agenda that was outside their focus, efforts, and capacities. The regional perspective was that adaptation efforts were both a benefit and a burden as regional leadership participants grappled with the concept. Where they sit allowed them to understand the challenges of translating a potentially useful concept into programs and practices that are relevant to the communities in their areas. Importantly, most participants understood adaptation as a pathway to help communities reimagine the role and outlook of wildfire—a pathway that may support efforts to better “share the loss, bear the loss, modify the event, prevent the effects, and change use or location” (Burton 1993), and may even lead to an understanding of the place of fire such that it may be tolerated on the landscape, where appropriate. In many ways, these conceptualizations demonstrate linkages participants are identifying among efforts, whether they be between short-term and longer term efforts, or across spatial scale and sector, that are mutually supportive and change our relationship with wildfire.

Importantly, skepticism among community leaders about the concept and programmatic developments associated with adaptation shines a light on gaps that could be bridged through efforts to integrate across national, regional, and community leadership. Suggestions that adaptation could be a shell game of fancy concepts developed at national levels are important flags that indicate the importance of engaging intersectoral and interscalar gaps more effectively. Translating the concept of adaptation to the community context and engaging a coproductive relationship on the ways in which adaptations may be locally relevant and meaningful will likely serve this effort. Importantly, research has yet to establish a consistent set of determinants of wildfire adaptation, and some urge caution in this pursuit due to variation in community context and local context and because locally identified needs are paramount for determining pathways to adaptation (Stidham et al. 2014, Paveglio et al. 2015, Paveglio 2016). If checklists are an important part of local processes upon which community leaders rely, it would behoove stakeholders at the regional and national levels to engage this issue in ways other than to dismiss it outright. Indeed, local processes that improve coping are not separate from, but are a part of, a larger adaptation agenda. Indeed, such short-term, smaller scale risk reduction activities and broader adaptations of policy and management may reflect different scales of the problem. We have not expected, and perhaps ought not to expect, households to “adapt;” rather, we expect them to engage in those behaviors that reduce risk, as appropriate in the stages of the disaster cycle they experience. Adaptation stands to be additive and to operate at a higher social scale than traditional household-level hazard mitigation activities, such that collaborative action can be taken to develop more resilient communities, fire response approaches, and policy approaches. Such efforts may support social and ecological systems in the face of the inevitable presence of wildfire.

[1] For programmatic resources and definitions of fire adaptation, see: <http://www.fireadapted.org/>

[2] FireWise of Southwest Colorado and Firewise USA™ constitute two separate organizations. FireWise of Southwest Colorado is a multicounty organization in southwest Colorado. Firewise USA™ is a national-level program of the National Fire Protection Association. Both programs advocate risk reduction activities among homeowners.

[3] All interviews were conducted in accordance of the University of Colorado's Institutional Review Board standards and guidelines.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/9471>

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LITERATURE CITED

- Abrams, J. B., M. Knapp, T. B. Paveglio, A. Ellison, C. Moseley, M. Nielsen-Pincus, and M. S. Carroll. 2015. Re-envisioning community-wildfire relations in the U.S. West as adaptive governance. *Ecology and Society* 20(3):34. <http://dx.doi.org/10.5751/ES-07848-200334>
- Adger, N. W. 2000. Social and ecological resilience: are they related? *Progress in Human Geography* 24(3):347–364. <http://dx.doi.org/10.1191/030913200701540465>
- Adger, W. N., N. W. Arnell, and E. L. Tompkins. 2005. Successful adaptation to climate change across scales. *Global Environmental Change* 15(2):77–86. <http://dx.doi.org/10.1016/j.gloenvcha.2004.12.005>
- Adger, W. N., S. Dessai, M. Goulden, M. Hulme, I. Lorenzoni, D. R. Nelson, L. O. Naess, J. Wolf, and A. Wreford. 2009. Are there social limits to adaptation to climate change? *Climatic Change* 93(3–4):335–354. <http://dx.doi.org/10.1007/s10584-008-9520-z>
- Allen, G. M., and E. M. Gould, Jr. 1986. Complexity, wickedness, and public forests. *Journal of Forestry* 84(4):20–23.
- Auerbach, C., and L. B. Silverstein. 2003. *Qualitative data: an introduction to coding and analysis*. New York University Press, New York, New York, USA.
- Berger, P. L., and T. Luckmann. 1991. *The social construction of reality: a treatise in the sociology of knowledge*. No. 10. Penguin, London, UK.
- Bihari, M., and R. Ryan. 2012. Influence of social capital on community preparedness for wildfires. *Landscape and Urban Planning* 106(3):253–261. <http://dx.doi.org/10.1016/j.landurbplan.2012.03.011>
- Bone, C., C. Moseley, K. Vinyeta, and R. P. Bixler. 2015. Employing resilience in the United States Forest Service. *Land Use Policy* 52:430–438. <http://dx.doi.org/10.1016/j.landusepol.2016.01.003>
- Boyatzis, R. E. 1998. *Transforming qualitative information: thematic analysis and code development*. Sage, Thousand Oaks, California, USA.
- Brenkert-Smith, H. 2008. *Placing wildfire in context: environmental and social dimensions of mitigation decision-making*. University of Colorado, Boulder, Colorado, USA.
- Brenkert-Smith, H., P. A. Champ, and N. Flores. 2012. Trying not to get burned: understanding homeowners' wildfire risk-mitigation behaviors. *Environmental Management* 50(6):1139–1151. <http://dx.doi.org/10.1007/s00267-012-9949-8>
- Brenkert-Smith, H., K. L. Dickinson, P. A. Champ, and N. Flores. 2013. Social amplification of wildfire risk: the role of social interactions and information sources. *Risk Analysis* 33(5):800–817. <http://dx.doi.org/10.1111/j.1539-6924.2012.01917.x>
- Burton, I. 1993. *The environment as hazard*. Guilford Press, New York, New York, USA.
- Busenberg, G. 2004. Wildfire management in the United States: the evolution of a policy failure. *Review of Policy Research* 21(2):145–156. <http://dx.doi.org/10.1111/j.1541-1338.2004.00066.x>
- Calkin, D. E., J. D. Cohen, M. A. Finney, and M. P. Thompson. 2014. How risk management can prevent future wildfire disasters in the wildland–urban interface. *Proceedings of the National Academy of Sciences of the United States of America* 111(2):746–751. <http://dx.doi.org/10.1073/pnas.1315088111>
- Carroll, M. S., K. A. Blatner, P. J. Cohn, and T. Morgan. 2007. Managing fire danger in the forests of the US Inland Northwest: a classic “wicked problem” in public land policy. *Journal of Forestry* 105(5):239–244.
- Clark, W. C., L. van Kerkhoff, L. Lebel, and G. C. Gallopin. 2016. Crafting usable knowledge for sustainable development. *Proceedings of the National Academy of Sciences of the United States of America* 113(17):4570–4578. <http://dx.doi.org/10.1073/pnas.1601266113>
- Clarke, L., and J. F. Short, Jr. 1993. Social organization and risk: some current controversies. *Annual Review of Sociology* 19:375–399. <http://dx.doi.org/10.1146/annurev.so.19.080193.002111>
- Cohn, P. J., M. A. Carroll, and Y. Kumagai. 2006. Evacuation behavior during wildfires: results of three case studies. *Western Journal of Applied Forestry* 21(1):39–48.
- Cutter, S. L., and C. T. Emrich. 2006. Moral hazard, social catastrophe: the changing face of vulnerability along the hurricane coasts. *Annals of the American Academy of Political and Social Science* 604(1):102–112. <http://dx.doi.org/10.1177/0002716205285515>
- Cvetkovich, G., and T. C. Earle. 1992. Environmental hazards and the public. *Journal of Social Issues* 48(4):1–20. <http://dx.doi.org/10.1111/j.1540-4560.1992.tb01942.x>

- Dickinson, K., H. Brenkert-Smith, P. A. Champ, and N. Flores. 2015. Catching fire? Social interactions, beliefs, and wildfire risk mitigation behaviors. *Society & Natural Resources* 28(8):807–824. <http://dx.doi.org/10.1080/08941920.2015.1037034>
- Dietz, T., P. C. Stern, and R. W. Rycroft. 1989. Definitions of conflict and the legitimation of resources: the case of environmental risk. *Sociological Forum* 4(1):47–70.
- Fischer, A. P., T. A. Spies, T. A. Steelman, C. Moseley, B. R. Johnson, J. D. Bailey, A. A. Ager, P. Bourgeron, S. Charnley, B. M. Collins, J.D. Kline, et al. 2016. Wildfire risk as a socioecological pathology. *Frontiers in Ecology and the Environment* 14(5):276–284. <http://dx.doi.org/10.1002/fee.1283>
- Gallopin, G. C. 1991. Human dimensions of global change: linking the global and the local processes. *International Social Science Journal* 43(4):707–718.
- Gamson, W. A., and A. Modigliani. 1989. Media discourse and public opinion on nuclear power: a constructionist approach. *American Journal of Sociology* 95(1):1–37. <http://dx.doi.org/10.1086/229213>
- Gibson, W., and A. Brown. 2009. *Working with qualitative data*. Sage, Thousand Oaks, California, USA. <http://dx.doi.org/10.4135/9780857029041>
- Greider, T., and L. Garkovich. 1994. Landscapes: the social construction of nature and the environment. *Rural Sociology* 59(1):1–24. <http://dx.doi.org/10.1111/j.1549-0831.1994.tb00519.x>
- Gude, P. H., K. Jones, R. Rasker, and M. C. Greenwood. 2013. Evidence for the effect of homes on wildfire suppression costs. *International Journal of Wildland Fire* 22(4):537–548. <http://dx.doi.org/10.1071/WF11095>
- Hammer, R. B., S. I. Stewart, and V. C. Radeloff. 2009. Demographic trends, the wildland–urban interface, and wildfire management. *Society & Natural Resources* 22(8):777–782. <http://dx.doi.org/10.1080/08941920802714042>
- Intergovernmental Panel on Climate Change (IPCC). 2014. Summary for policymakers. Pages 1–32 in C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, and L. L. White, editors. *Climate change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.
- Jakes, P. J., L. Kruger, M. Monroe, K. Nelson, and V. Strurtevant. 2007. Improving wildfire preparedness: lessons from communities across the U.S. *Human Ecology Review* 14(2):188–197.
- Jarrett, A., J. Gan, C. Johnson, and I. A. Munn. 2009. Landowner awareness and adoption of wildfire programs in the southern United States. *Journal of Forestry* 107(3):113–118.
- Jolly, W. M., M. A. Cochrane, P. H. Freeborn, Z. A. Holden, T. J. Brown, G. J. Williamson, and D. M. J. S. Bowman. 2015. Climate-induced variations in global wildfire danger from 1979 to 2013. *Nature Communications* 6:7537. <http://dx.doi.org/10.1038/ncomms8537>
- Kelman, I., J. C. Gaillard, J. Lewis, and J. Mercer. 2016. Learning from the history of disaster vulnerability and resilience research and practice for climate change. *Natural Hazards* 82(1):129–143. <http://dx.doi.org/10.1007/s11069-016-2294-0>
- Knorr, W., L. Jiang, and A. Arneith. 2016. Climate, CO² and human population impacts on global wildfire emissions. *Biogeosciences* 13(1):267. <http://dx.doi.org/10.5194/bg-13-267-2016>
- Kousky, C. 2014. Informing climate adaptation: a review of the economic costs of natural disasters. *Energy Economics* 46:576–592. <http://dx.doi.org/10.1016/j.eneco.2013.09.029>
- Kozlowski, T. T., and C. E. Ahlgren. 1974. *Fire and ecosystems*. Academic Press, Cambridge, Massachusetts, USA.
- Landres, P. B., P. Morgan, and F. J. Swanson. 1999. Overview of the use of natural variability concepts in managing ecological systems. *Ecological Applications* 9(4):1179–1188.
- Lecompte, M. D., and J. Preissle. 1993. *Ethnography and qualitative design in educational research*. Second edition. Academic Press, San Diego, California, USA.
- Lockwood, M. 2010. Good governance for terrestrial protected areas: a framework, principles and performance outcomes. *Journal of Environmental Management* 91(3):754–766. <http://dx.doi.org/10.1016/j.jenvman.2009.10.005>
- Lofland, J., and L. Lofland. 1995. *Analyzing social settings: a guide to qualitative observation and analysis*. Third edition. Wadsworth Publishing Company, Belmont, California, USA.
- Lueck, D. 2012. Economics and the organization of wildfire suppression. Pages 71–88 in K. Bradshaw and D. Lueck, editors. *Wildfire policy: law and economics perspectives*. Resources for the Future, New York, New York, USA.
- Maiello, A., C. V. Viegas, M. Frey, and J. L. D. Ribeiro. 2013. Public managers as catalysts of knowledge co-production? Investigating knowledge dynamics in local environmental policy. *Environmental Science & Policy* 27:141–150. <http://dx.doi.org/10.1016/j.envsci.2012.12.007>
- Martin, W. E., I. M. Martin, and B. Kent. 2009. The role of risk perceptions in the risk mitigation process: the case of wildfire in high risk communities. *Journal of Environmental Management* 91(2):489–498. <http://dx.doi.org/10.1016/j.jenvman.2009.09.007>
- McCaffrey, S. 2015. Community wildfire preparedness: a global state-of-the-knowledge summary of social science research. *Current Forestry Reports* 1(2):81–90. <http://dx.doi.org/10.1007/s40725-015-0015-7>
- McCaffrey, S., A. Rhodes, and M. Stidham. 2015. Wildfire evacuation and its alternatives: perspectives from four United States’ communities. *International Journal of Wildland Fire* 24(2):170–178. <http://dx.doi.org/10.1071/WF13050>
- McCaffrey, S., E. Toman, M. Stidham, and B. Shindler. 2013. Social science research related to wildfire management: an overview of recent findings and future research needs. *International Journal of Wildland Fire* 22(1):15–24. <http://dx.doi.org/10.1071/WF11115>
- McGee, T. K., and S. Russell. 2003. “It’s just a natural way of life...” an investigation of wildfire preparedness in rural

- Australia. *Global Environmental Change Part B: Environmental Hazards* 5(1):1–12. <http://dx.doi.org/10.1016/j.hazards.2003.04.001>
- McPhee, J. 1989. *The control of nature*. Macmillan, New York, New York, USA.
- Mockrin, M. H., S. I. Stewart, V. C. Radeloff, R. B. Hammer, and P. M. Alexandre. 2015. Adapting to wildfire: rebuilding after home loss. *Society & Natural Resources* 28(8):839–856. <http://dx.doi.org/10.1080/08941920.2015.1014596>
- Moritz, M. A., E. Batllori, R. A. Bradstock, A. M. Gill, J. Handmer, P. F. Hessburg, J. Leonard, S. McCaffrey, D. C. Odion, T. Schoennagel, and A. D. Syphard. 2014. Learning to coexist with wildfire. *Nature* 515(7525):58–66. <http://dx.doi.org/10.1038/nature13946>
- National Cohesive Wildland Fire Management Strategy (National Cohesive Strategy). 2011. [online] URL: <https://www.forestsandrangelands.gov/strategy/>
- Norris, F. H., S. P. Stevens, B. Pfefferbaum, K. F. Wyche, and R. L. Pfefferbaum. 2008. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology* 41(1–2):127–150. <http://dx.doi.org/10.1007/s10464-007-9156-6>
- Olson, R., and D. N. Bengtson. 2015. A world on fire. AAI Foresight Report 2: Spring/summer. Freeland, WA: AAI Foresight. [online] URL: <http://www.aaiforesight.com/content/world-fire>
- Olson, R. L., D. N. Bengtson, L. A. DeVaney, and T. A. Thompson. 2015. Wildland fire management futures: insights from a foresight panel. U.S. Forest Service General Technical Report NRS-152. <http://dx.doi.org/10.2737/NRS-GTR-152>
- O’Neill, K. M. 2006. *Rivers by design: state power and the origins of U.S. flood control*. Duke University Press, Durham, North Carolina, USA. <http://dx.doi.org/10.1215/9780822387862>
- Parisien, M. A., S. Snetsinger, J. A. Greenberg, C. R. Nelson, T. Schoennagel, S. Z. Dobrowski, and M. A. Moritz. 2012. Spatial variability in wildfire probability across the western United States. *International Journal of Wildland Fire* 21(4):313–327. <http://dx.doi.org/10.1071/WF11044>
- Patton, M. Q. 2002. Two decades of developments in qualitative inquiry: a personal, experiential perspective. *Qualitative Social Work* 1(3):261–283. <http://dx.doi.org/10.1177/1473325002001003636>
- Paveglio, T. B., J. Abrams, and A. Ellison. 2016. Developing fire adapted communities: the importance of interactions among elements of local context. *Society & Natural Resources* 29(10):1246–1261. <http://dx.doi.org/10.1080/08941920.2015.1132351>
- Paveglio, T. B., M. S. Carroll, and P. J. Jakes. 2010. Alternatives to evacuation during wildland fire: exploring adaptive capacity in one Idaho community. *Environmental Hazards* 9(4):379–394. <http://dx.doi.org/10.3763/ehaz.2010.0060>
- Paveglio, T. B., M. S. Carroll, P. J. Jakes, and T. Prato. 2012. Exploring the social characteristics of adaptive capacity for wildfire: insights from Flathead County, Montana. *Human Ecology Review* 19(2):110–124.
- Paveglio, T. B., P. J. Jakes, M. S. Carroll, and D. R. Williams. 2009. Understanding social complexity within the wildland–urban interface: a new species of human habitation? *Environmental Management* 43(6):1085–1095. <http://dx.doi.org/10.1007/s00267-009-9282-z>
- Paveglio, T. B., C. Moseley, M. S. Carroll, D. R. Williams, E. J. Davis, and A. P. Fischer. 2015. Categorizing the social context of the wildland urban interface: adaptive capacity for wildfire and community “archetypes.” *Forest Science* 61(2):298–310. <http://dx.doi.org/10.5849/forsci.14-036>
- Pyne, S. J. 2015. *Between two fires: a fire history of contemporary America*. University of Arizona Press, Tucson, Arizona, USA.
- Rasker, R. 2015. Resolving the increasing risk from wildfires in the American West. *Solutions* 6(2):48–55.
- Rodin, J. 2014. *The resilience dividend: being strong in a world where things go wrong*. Rockefeller Foundation, New York, New York, USA.
- Ryan, G. W., and H. R. Bernard. 2003. Techniques to identify themes. *Field Methods* 15(1):85–109. <http://dx.doi.org/10.1177/1525822X02239569>
- Schoennagel, T., J. Balch, H. Brenkert-Smith, P. E. Dennison, B. J. Harvey, M. A. Krawchuk, N. Miekiewicz, P. Morgan, M. A. Moritz, R. Rasker, M. G. Turner, and C. Whitlock. 2017. Adapt to more wildfire in western North America as climate changes. *Proceedings for the National Academy of Sciences of the United States of America* 114(18):4582–4590. <http://www.pnas.org/content/114/18/4582>
- Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang. 2012. Changes in climate extremes and their impacts on the natural physical environment. Pages 109–230 in C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor, and P. M. Midgley, editors. *Managing the risks of extreme events and disasters to advance climate change adaptation*. Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, New York, USA. <http://dx.doi.org/10.1017/CBO9781139177245.006>
- Simpson, R. 1996. Neither clear nor present: the social construction of safety and danger. *Sociological Forum* 11(3):549–562.
- Smit, B., and J. Wandel. 2006. Adaptation, adaptive capacity and vulnerability. *Global Environmental Change* 16(3):282–292. <http://dx.doi.org/10.1016/j.gloenvcha.2006.03.008>
- Spector, M., and J. I. Kitsuse. 1987. *Constructing social problems*. Transaction Publishers, Brunswick, New Jersey, USA.
- Stallings, R. A. 1995. *Promoting risk: constructing the earthquake threat*. Aldine de Gruyter, New York, New York, USA.
- Steelman, T. 2016. U.S. wildfire governance as social-ecological problem. *Ecology and Society* 21(4):3. <http://dx.doi.org/10.5751/ES-08681-210403>

- Steelman, T. A., and C. A. Burke. 2007. Is wildfire policy in the United States sustainable? *Journal of Forestry* 105(2):67–72.
- Stephens, S. L., J. K. Agee, P. Z. Fulé, M. P. North, W. H. Romme, T. W. Swetnam, and M. G. Turner. 2013. Managing forests and fire in changing climates. *Science* 342(6154):41–42. <http://dx.doi.org/10.1126/science.1240294>
- Stephens, S. L., and L. W. Ruth. 2005. Federal forest-fire policy in the United States. *Ecological Applications* 15(2):532–542.
- Stidham, M., C. Olsen, E. Toman, S. Frederick, S. McCaffrey, and B. Shindler 2014. Longitudinal social science research in natural resource communities: lessons and considerations. *Society & Natural Resources* 27(10):1104–1108. <http://dx.doi.org/10.1080/08941920.2014.905895>
- Strauss, A., and J. Corbin. 1998. *Basics of qualitative research techniques and procedures for developing grounded theory*. Second edition. Sage Publications, Newbury Park, California, USA.
- Thomas, D. S. G., C. Twyman, H. Osbahr, and B. Hewitson. 2007. Adaptation to climate change and variability: farmer responses to intra-seasonal precipitation trends in South Africa. *Climatic Change* 83(3):301–322. <http://dx.doi.org/10.1007/s10584-006-9205-4>
- Tidwell, T. 2013. Guest commentary: millions of acres are now more resilient to wildfire. The Denver Post. Sept. 23, 2013.
- Tierney, K. J. 2014. *The social roots of risk: producing disasters, promoting resilience*. Stanford University Press, Stanford, California, USA.
- Tierney, K. J. 2015. Resilience and the neoliberal project: discourses, critiques, practices--and Katrina. *American Behavioral Scientist* 59(10):1327–1342.
- Tierney, K. J., M. K. Lindell, and R. W. Perry, editors. 2001. *Facing the unexpected: disaster preparedness and response in the United States*. Joseph Henry Press, Washington, D.C., USA.
- Tugade, M. M., B. L. Fredrickson, and L. F. Barrett. 2004. Psychological resilience and positive emotional granularity: examining the benefits of positive emotions on coping and health. *Journal of Personality* 72(6):1161–1190. <http://dx.doi.org/10.1111/j.1467-6494.2004.00294.x>
- United States Department of Agriculture [USDA] Forest Service and Aviation Management and United States Department of the Interior [USDI]. 2014. 2014 quadrennial fire review: final report. Washington, D.C., USA. [online] URL: <https://www.forestsandrangelands.gov/QFR/documents/2014QFRFinalReport.pdf>
- United States Forest Service (USFS). 2015. The rising cost of fire operations: effects on the Forest Service's non-fire work. [online] URL: <https://www.fs.fed.us/sites/default/files/2015-Fire-Budget-Report.pdf>
- Vedwan, N., and R. E. Rhoades. 2001. Climate change in the Western Himalayas of India: a study of local perception and response. *Climate Research* 19(2):109–117. <http://dx.doi.org/10.3354/cr019109>
- Westerling, A. L., H. Hidalgo, D. R. Cayan, and T. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. *Science* 313(5789):940–943. <http://dx.doi.org/10.1126/science.1128834>