WILDFIRE PREPAREDNESS AND EVACUATION PLANNING IN A PANDEMIC

Case studies from California and Colorado   June 2021

Acknowledgements

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CONTENTS

SUMMARY

This report presents key findings, conclusions, and recommendations from a longitudinal research study on wildfire preparedness and evacuation planning in a pandemic (CONVERGE 2020).

The research aim was to understand the social, ecological, and public health dimensions of wildfires in a pandemic. The objective was to examine how communities in two locations at high risk from wildfires – Nevada County in California and Larimer County in Colorado – perceived and practiced safety as they prepared for wildfires (June – August 2020) and recovered from wildfires (November 2020 – February 2021) during the COVID-19 pandemic.

The research findings emphasize the need to develop a convergent approach to addressing compound hazards. This will be especially important as communities in the western United States cope with extreme drought, high wildfire risk, poor air quality, and public safety power shutoffs, amid the long-term impacts of the COVID-19 pandemic, housing instability, food insecurity, and racial injustice.

Section I–*Overview*, provides a brief review of recent academic and policy literature to contextualize key trends observed in wildfire preparedness and evacuation planning during the first year of the COVID-19 pandemic, in 2020.

Section II–*Method*, presents the qualitative research method and convergence approach to understanding the wildfire-pandemic interface, with the objective of enabling similar research in communities living with compound hazards.

Section III–*Findings*, draws on examples from Nevada County in California, and Larimer County in Colorado, to examine the ways in which institutions and communities coped with the wildfire–pandemic interface in 2020. The section assesses how some of these changes are likely to be beneficial and possibly long-lasting.

Section IV–*Conclusions*, presents a conceptual framework to characterize the evolving wildfire-pandemic interface along three interrelated dimensions: social, ecological, and public health. The section makes the case for why policy, programs, and research will need to converge around a better understanding of these dimensions to holistically address the wildfire-pandemic interface in inclusive, just, and equitable ways.

Section V–*Recommendations*, presents actionable recommendations for adopting convergence approaches to living with the wildfire-pandemic interface across diverse social geographies.

The report contributes new insights for wildfire preparedness and evacuation planning as the United States continues to face compound hazards in 2021, and beyond.

SECTION I: OVERVIEW

In 2020, the western United States experienced profound impacts from compound hazards. This research report examines how institutions and communities in two case study locations – Nevada County in California and Larimer County in Colorado – coped with the deadly COVID-19 pandemic while responding to historic wildfires.

The COVID-19 pandemic significantly changed how wildfire preparedness, evacuation planning, response, and recovery efforts were implemented across the United States in 2020. The pandemic affected how institutions conducted fuel management, public outreach and awareness, emergency alerts and communication, evacuee transportation and sheltering, fire camp management, mutual aid, and resource management (NWCG 2020). The pandemic also affected how communities conducted fuel management, defensible space work, home hardening, evacuations, sheltering, and returns – in some cases, from multiple fires.

As of June 2021, these changes continue to have far reaching but inadequately understood impacts on the social, ecological, and public health dimensions of life in the United States. This report seeks to address knowledge gaps and enable institutions and communities across the western United States to adapt to the evolving wildfire-pandemic interface in 2021, and beyond.

This first section provides a review of recent literature to outline key trends in wildfire preparedness and evacuation planning during the first year of the COVID-19 pandemic. This synthesis of key issues is based on content analysis of 74 secondary literature sources, including academic articles, institutional websites, policy documents, legislation, social media, and news sources (see *References* for a complete list).

Since early 2020, policy, research, and media reports have highlighted four main aspects of the wildfire-pandemic interface: a) suppression and response, b) evacuation and shelter planning, c) fuel mitigation, and d) wildfire smoke as a public health concern. Key issues are summarized below.

1   Suppression and response

Personnel availability and safety
In 2020, jurisdictions across the western United States generally fell short on staff and crews for fire suppression and response (McDermott 2020). Health-related risks limited the availability and participation of personnel in risk mitigation activities (Culver 2020; Fentress and Fausset 2020; Pierre-Louis 2020). Due to COVID-19 related health protocols and restrictions, units that would normally contribute to domestic, regional, and international mutual aid efforts in the form of personnel and equipment could not fully mobilize (Schmitt 2020). Specifically, California faced a significant restriction

in mobilizing fire crews due to how COVID-19 affected the state prison system. In past years, inmate crews made significant contributions to wildfire suppression and response but during the COVID-19 pandemic, many inmate crews were either in quarantine or released early to mitigate virus transmission in prisons (Anderson and Brown 2020; Farrer et al. 2020; Field and Appel 2020; Fuller 2020; Levin 2020). Some jurisdictions received more support from their state agencies but COVID-19 significantly cut into state budgets with long-term fiscal impacts (*Daily Californian* 2020; Phillips 2020; *Postmedia Breaking News* 2020; Shadley 2021; Silvers 2021; Singh 2020b). These changes in personnel availability and resource constraints led to general uncertainty around local response arrangements and public safety.

Re-organizing fire camps in line with COVID-19 health and safety guidance

Major changes were implemented in fire camps due to new and rapidly changing health and safety guidance. Fire camps are particularly ill-suited to social distancing measures with group travel to the site, long and strenuous working hours, and close living conditions (Anderson and Brown 2020; Boone 2020; Carlisle 2020; Dunphey 2020; Edgeley and Burnett 2020; Navarro et al. 2021; Singh 2020a). This was dealt with by organizing smaller camps with virtual briefings to limit interactions with the public and other teams so each unit could safely work in close proximity (Ackerman 2020; Boone 2020; Crighton 2020; Dunphey 2020; Giacomelli 2020; Lamb-Yorski 2020; Martinez 2020; Navarro et al. 2021; Singh 2020a ; Singh 2020b; *The Calgary Herald* 2020; *Postmedia Breaking News* 2020). These preventative and hygiene protocols generally reduced incidences of camp crud. In terms of adapting fire response to COVID-19, some actions like cutting the fire lines were found to be low-risk in a pandemic because crews are already expected to be at least 10 feet apart (Schmitt 2020). Other activities were adapted to social distancing requirements, for example in organizing shelters. Whereas pre-COVID, one fairground may have been used with the new social distancing guidance, several different kinds of accommodations had to be planned (Farrer et al. 2020; Schmitt 2020). However, this did not pose a logistical challenge as fairgrounds were mostly empty because of public gathering restrictions so there was not much competition for other uses of the space (Schmitt 2020).

Personal Protective Equipment (PPE) stocks and supply

Some fire crews and local emergency response agencies reported initial challenges in procuring relevant and sufficient PPE for personnel and contractors. People initially wore home-made cloth masks due to the shortage of N95 masks. While cloth and medical masks may help mitigate transmission of COVID-19, the only protection from the particulate matter of wildfire smoke is a well-fitted N95 mask which has seen extensive supply shortages and were prioritized for medical professionals (Cowan 2020; Henderson 2020; Kekatos 2020; Santana et al. 2020). However, over the months, and certainly before fire season, supply chains were fully functional and PPE needs were mostly being met for fire crews and emergency personnel.

2 Evacuation and shelter planning

Risk communication and safety messages during compound hazards
In the first year of the pandemic, there may have been some confusion around protective actions recommended for wildfire evacuations. Through the first half of 2020, people received consistent public health guidance to 'stay home' and practice social distancing to stay safe from COVID-19 transmissions. However, with the onset of wildfires across the western United States in July–September 2020, public safety messaging quickly shifted to emphasize the importance of 'leaving early' and sheltering away from home even as pandemic cases surged. At this point, there is insufficient research on how people responded to these conflicting public safety messages.

Risk perception of wildfire threat during a deadly pandemic
Some studies sought to understand if Wildland-Urban Interface (WUI) communities recently affected by wildfires perceived COVID-19 as a factor in wildfire safety (e.g., Edgeley and Burnett 2020). It was found that while experiencing multiple hazards simultaneously is not a new occurrence, people are prone to optimism bias where they understand themselves to be able to avoid the worst of hazards no matter the circumstance. Challenges regarding collective action to address wildfire risk may have been exacerbated by COVID-19 health and safety precautions (Kuligowski and Gwynne 2020). The pandemic widened existing disparities in household capacity to conduct wildfire risk mitigation actions. Past research has shown that successful evacuations usually require in-person information and check-ins by law enforcement personnel (Kuligowski and Gwynne 2020). However, with COVID-19 related restrictions and personnel shortages, door to door checks and support for evacuation planning considerably reduced in 2020 (Wong et al. 2020).

Logistics and shelter planning
Public sheltering was initially suggested as a last resort during the COVID-19 pandemic, so people were more limited in their options. In previous years, people may have sheltered with family members or friends but the pandemic brought the additional risk of virus transmission, especially to older adults (Edgeley and Burnett 2020). However, by October 2020, the record for number of people sheltered by the Red Cross in the United States had already been exceeded and was well over four times the annual average (Flavelle 2020). This of course meant the nature of sheltering itself changed in the past year. For example, the Red Cross and local agencies did not deploy congregate sheltering, but instead, mainly used hotels and smaller community shelters, including schools. Also, lessons from past years were largely successfully applied during 2020. Disaster sheltering protocols regularly account for infectious diseases, such as outbreaks of colds, flus, and norovirus, including sheltering in environments that do not have the resources to maintain sanitary standards (Boone 2020; Edgeley and Burnett 2020; Fuller 2020; Pierre-Louis 2020; Schmitt 2020). In this sense, sheltering was not necessarily a new adaptation to the wildfire-pandemic interface, except perhaps in planning for the severity of COVID-19 transmission rates. Shortages of cleaning and medical supplies in many cases complicated the cleaning

routines required to avoid infection during mass sheltering (Rice 2020). For example, during hurricane season some jurisdictions switched from school gyms to smaller scale sheltering like classrooms or even hotel rooms and separate sheltering for COVID-19 positive evacuees (Borenstein 2020; Boone and Cline 2020; Fuller 2020; Rice 2020). For most shelters, adapting to social distancing meant lowering capacity to create more space between beds and tables. This also required more personnel time to disinfect and either stagger meal times or package individual meals (Boone and Cline 2020; Schmitt 2020). Early in 2020, the Red Cross invested in laptops, wireless hotspots, and mobile devices to provide services virtually, including mental health support and financial assistance (Rice 2020).

3   Fuel mitigation

Defensible space

Progress with fuel mitigation work varied greatly across regions during the first year of the COVID-19 pandemic. Many of the preparatory actions that normally take place during each year, like trainings or inspecting and reducing brush as well as prescribed burns were cancelled, leaving many firefighting units undertrained and local concerns with fuel overload unaddressed (Ackerman 2020; Carlisle 2020; Coleman 2020; Culver 2020; Edgeley and Burnett 2020; Ferguson 2020; Field and Appel 2020; *Houston Today* 2020; Stevens 2020; *The Calgary Herald* 2020; *The Vancouver Sun* 2020; Pierre-Louis 2020; *Postmedia Breaking News* 2020; Lamb-Yorski 2020; Martinez 2020; *Vernon Morning Star* 2020).

Household preparedness

Most public safety messaging focused on encouraging personal preparedness and home mitigation efforts to make up for the perceived lack of activity from public agencies due to COVID-19 restrictions (Pierre-Louis 2020; Lister 2020; *The Free Press* 2020; *The Vancouver Sun* 2020; Ackerman 2020). It was found that more time at home allowed for more mitigation activities on private land which became important given that routine mitigation efforts on public lands were often cancelled in 2020 (Edgeley and Burnett 2020; Field and Appel 2020; Pierre-Louis 2020). However, the research also shows that many people did not have the means to participate in personal, family, and household preparedness measures due to unemployment and lower incomes, thereby contributing to a perceptible wildfire preparedness gap during the first year of the pandemic (Clayton 2020). Some evidence suggests that older adults and people with disabilities who would normally receive assistance with fuel mitigation activities generally had limited assistance in 2020 due to COVID-19 restrictions which led to a decline in community volunteers in some cases (Edgeley and Burnett 2020).

Public Safety Power Shutoffs

As part of its wildfire mitigation program in California, Pacific Gas and Electric (PG&E) continued to implement public safety power shutoffs (PSPSs). In September 2020, at the peak of California's fire season, the PSPSs affected over 250,000 customers, of which most were categorized as residential, while the rest included medical baseline customers, and commercial/ industrial customers. While new

kinds of outreach programs such as the Disability Disaster Access and Resources program enabled better preparation among people with access, functional, and linguistic needs, the PSPSs left people without power on the warmest days and often without access to public cooling centers due to COVID-19 restrictions on congregate shelters and gatherings (Farrer et al., 2020; Fuller 2020; Singh 2020a) . Finally, it was found that recovery took longer because of a lack of volunteers and risk of exposure for people like utility workers that would normally be working overtime to restore utilities (Borenstein 2020).

Use of public lands and forests

Even as fuel mitigation activities reduced on public lands across the western United States in 2020, more people accessed public lands for recreational purposes than ever before to escape pandemic related restrictions in towns and city centers. Interestingly, this U.S. wide trend was not found in other parts of the world. For example, Mediterranean countries experienced strict COVID-19 lockdowns and widespread quarantines thereby drastically reducing the kind of behavior that contributes to human-caused wildfires (Rodrigues et al. 2021). Western Canada experienced similar decreases in wildfires from fire bans and off-highway vehicle bans during the COVID-19 lockdowns (Crighton 2020; Dawson 2020a and 2020b). In contrast, the United States experienced record numbers of people accessing public lands for camping and recreational purposes to escape lockdowns. This surge in the use of public lands resulted in extreme wildfire risk for WUI communities from human-caused ignitions as well as more complex planning required for outreach, transportation, evacuations, and sheltering due to pandemic health and safety protocols (Cowan 2020; Lister 2020; Martinez 2020; Shadley 2021).

4   Wildfire smoke as a public health concern

Managing smoke impacts, especially in the context of exacerbated health risk from COVID-19

Public health research largely focused on examining how wildfire smoke could worsen COVID-19 symptoms and co-morbidities among fire crew personnel and community at large. Wildfire smoke is measured by elevated fine particulate matter ($PM_{2.5}$) and is associated with increased vulnerability to any respiratory disease or infection, especially COVID-19 (Henderson 2020). Studies during the SARS outbreak in 2003 showed a 6% increase in mortality risk for every additional 10 microgram per cubic meter increase of PM_{10} ($PM_{2.5}$ or larger) (Henderson 2020; *The Vancouver Sun* 2020) and studies in the US found a 22% increase of seasonal influenza following times with elevated $PM_{2.5}$ from the summer wildfire season (Navarro et al. 2021). Case comparisons during COVID-19 so far have seen a positive relationship between wildfire smoke and increased cases. In one particular study, a 10% increase in COVID-19 outbreak was witnessed approximately one week following moderate wildfire smoke (Henderson 2020; Kekatos 2020; Leifer et al. 2021; Meo et al. 2020; Meo et al. 2021). More broadly, increased numbers of infections were reported in areas with lower air quality, including from wildfire smoke (Cowan 2020; Edgeley and Burnett 2020; Fuller 2020; Kekatos 2020; Henderson 2020; *The Santa Fe New Mexican* 2020; *The Vancouver Sun* 2020).

Social-economic disparities exacerbated during compound hazards

Recent literature has pointed to how existing racial, ethnic, gender, and economic inequalities have been further exacerbated by the wildfire–pandemic interface. For example, seasonal migrant and farm workers were at greater risk from respiratory illness due to increased exposure to wildfire smoke while remaining ineligible for federal aid (Méndez et al. 2020). It was reported that COVID-19 related safety and health messages did not always reach non-English speaking populations. These issues were not just around outreach but also lack of cultural context. For example, there is no exact word for 'virus' in some languages (Méndez et al. 2020). Learning from the 2017 Tubbs Fire, some larger cities in California undertook efforts to address wildfire and COVID-19 related messaging with messaging in Spanish, Tagalog, Chinese, and Korean. However, these messages did not necessarily reach the intended audience, such as many farm workers, who may live in rural areas, not near highways and billboards (Clayton 2020; Vives 2020).

SECTION II: METHOD

The aim of this qualitative research was to critically examine the social, ecological, and public health dimensions of wildfire preparedness and evacuation planning in a pandemic. The research objective was to examine how communities in two locations at high-risk from wildfires–Nevada County in California and Larimer County in Colorado–perceived and practiced safety as they prepared for wildfires and recovered from wildfires during the COVID-19 pandemic. The two case study locations were chosen due to their high risk from wildfires (see Tables 1-3) and because some Working Group members could reach out to existing local networks and facilitate virtual research interviews during COVID-19 restrictions.

The research data consists of 49 semi-structured research interviews conducted virtually across two time series, engaging a total of 28 research participants across both case study locations and time series. See Figures 1 and 2 for details by location and time series. In-depth interviews were conducted with institutional representatives from fire management, forest management, emergency management, key utilities such as water and electricity, and with community representatives from volunteer networks, including Firewise communities and prescribed burn associations, and a range of regional and community-based organizations. The interviews were conducted virtually on Zoom, lasted between 30 to 90 minutes, audio recorded with prior consent, transcribed verbatim, and anonymized to protect the privacy of research participants.

A first round of research interviews was conducted before the fires, between June–August 2020, with 17 research participants in California and 10 research participants in Colorado. A second round of interviews was conducted after the fires, between November 2020–February 2021, with 14 research participants in California and 8 research participants in Colorado. Most interviews were repeated with the same research participants in the second time series, except for three in California, and two in Colorado, due to research participant unavailability. Across both time series, interviews were conducted with a total of 18 research participants in California and 10 research participants in Colorado.

In the first round of semi-structured interviews, conducted between June – August 2020, four key questions were asked of institutional representatives from fire management, emergency management, water and electricity utilities, and state/ local organizations focused on preparedness (see Appendix A for the complete Interview Guide):

1. What kind of wildfire preparedness work is your agency continuing to perform in the context of COVID-19 related health and safety concerns?
2. How is your agency keeping staff, workers, and volunteers safe, with adequate access to appropriate personal protective equipment?

3. In what ways do you think wildfire preparedness and evacuation planning is changing due to the pandemic?
4. Looking into the future, what are some innovative or alternative ways to address wildfire mitigation, preparedness, and evacuation planning efforts?
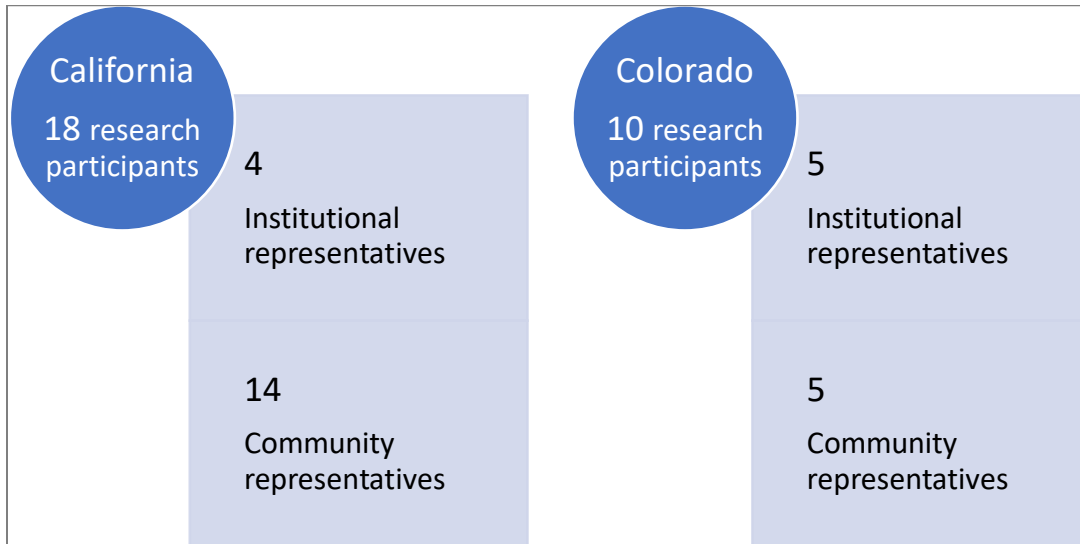

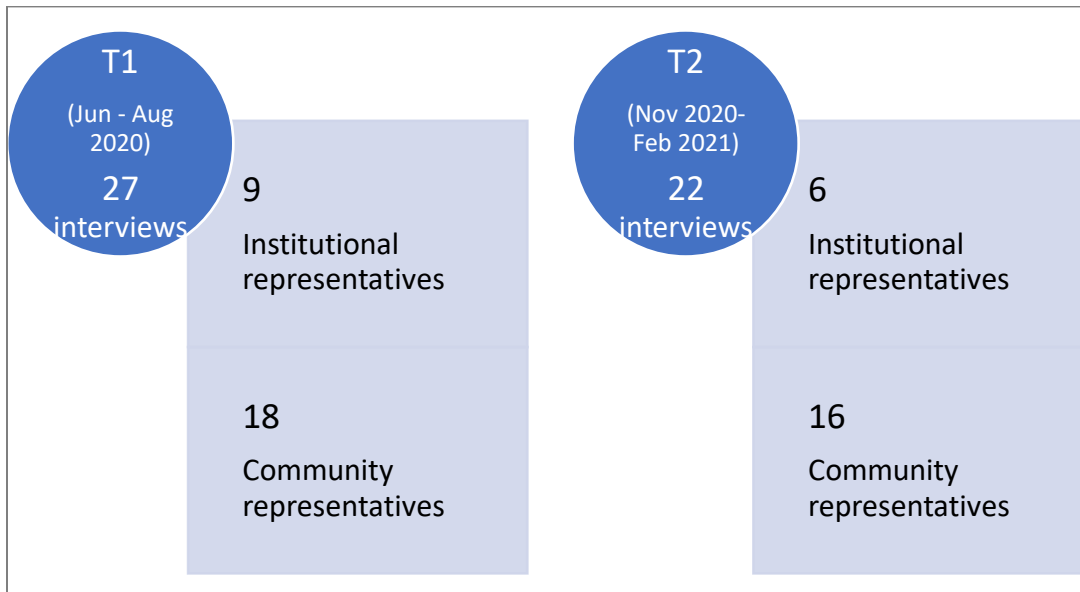**Figure 1: Research participants by study location**

Figure 2: Research interviews by time series

During the same period, between June–August 2020, similar questions were posed to community representatives from Firewise communities, community-based organizations, small business owners, and volunteer networks (see Appendix A for the complete Interview Guide):

1. How is your community continuing work in the context of COVID-19 related health and safety concerns?
2. What are some of the things you're doing, personally and in the community, to keep safe from wildfires and the COVID-19 pandemic?
3. In what ways do you think your community's wildfire preparedness and evacuation planning is changing due to the pandemic?
4. Looking into the future, what do you think could be some innovative or alternative ways to address wildfire mitigation, preparedness, and evacuation planning efforts?

In the second round of semi-structured interviews, conducted between November 2020—February 2021, four follow-up questions were asked of institutional representatives from regional fire management and local emergency management (see Appendix B for the complete Interview Guide):

1. How did your agency respond to the fire siege of 2020? What were the key challenges and successes?
2. How did you keep your staff, workers, and volunteers safe from wildfires, cascading impacts including smoke, and the ongoing pandemic?
3. What were the biggest lessons from your experience in 2020?
4. Going into 2021, what kinds of fundamental shifts will be required for wildfire resilience? How can we become better adapted to living with fire?

During the same period, November 2020—February 2021, four similar questions were asked of community representatives from Firewise communities, community-based organizations, small business owners, and volunteer networks (see Appendix B for the complete Interview Guide):

1. How did your community cope with the fire siege of 2020?
2. What are some of the things the community did to keep safe from the wildfires, lingering smoke, public safety power shutoffs, and COVID-19 over the summer?
3. What are some of the biggest lessons from the community's experience in 2020?
4. Going into 2021, what kinds of fundamental shifts will be required for wildfire resilience? How can we become better adapted to living with fire?

The research interviews were first transcribed using professional transcription services. The transcriptions were then checked against the audio recording by at least one Working Group member and finally reviewed by the lead author. Next, the transcripts were thematically analyzed (Saldana 2013) using the computer-assisted qualitative data analysis software program, NVivo Mac (Bazeley & Jackson 2007; Saldana 2013). The objective was to generate broad themes that confirmed, further explained, expanded, or refuted and challenged the three *a priori* themes explored during the research interviews: 1) social, ecological, and public health dimensions of wildfire preparedness and evacuation planning in a pandemic, 2) beliefs, attitudes, and perceptions of safety from wildfires in a pandemic, and 3) everyday practices for feeling safe and secure from wildfires in a pandemic. The next section

presents key themes from qualitative data collected during research interviews in each case study location. The key themes identify interdependencies across three dimensions; social, ecological, and public health (see Section IV: *Conclusions* for discussion).

The lead author also maintained in-depth notes before, during, and after research interviews, virtual conversations, and email correspondences, from June 2020 until February 2021. The themes generated from coding the transcripts were triangulated by coding reflections and observations from broader discussions around wildfire preparedness and evacuation planning, such as during virtual Town Hall meetings (e.g., Nevada County Coalition of Firewise Communities) and public research webinars (e.g., the California Fire Science Seminars, among others).

Finally, a note on terminology. Adapted from the Culture and Disaster Action Network, this report refers to *compound hazards* as 'the combination of physical environmental processes that have the potential to result in harm' to communities and habitats (CADAN 2020, p. 6). The next section, *Findings*, presents key findings from institutional and community experiences before, during, and after the fires in Nevada County, California and Larimer County, Colorado.

SECTION III: FINDINGS

With the onset of the global COVID-19 pandemic in early 2020, there was considerable uncertainty regarding how wildfire preparedness, response, and recovery would unfold in the context of compounding social, ecological, and public health hazards. As highlighted in Section I–*Overview*, it was generally anticipated that the pandemic would worsen conditions for institutions and communities alike.

However, this section seeks to present a more nuanced view of how institutions and communities experienced the wildfire-pandemic interface in Nevada County, California and Larimer County, Colorado. The section first briefly contextualizes the relative wildfire risk and vulnerability profiles, and COVID-19 caseloads for both case study locations. The section then summarizes key trends regarding the social, ecological, and public health dimensions of the wildfire-pandemic interface across both locations. Finally, the section concludes with key lessons for wildfire preparedness and evacuation planning from each case study location.

Wildfire risk and vulnerability profiles

Table 1: Relative Wildfire Risk

Percentile rank (0-100)	Statewide rank Nevada County, California	Nationwide rank California	Statewide rank Larimer County, Colorado	Nationwide rank Colorado
Wildfire likelihood	72	98	67	68
Risk to homes	79	96	65	74

Source: Headwater Economics. 2021. Economic Profile System, Natural Hazards. Accessed 31 March 2021. https://headwatereconomics.org/eps.

Table 1 presents an overview of relative wildfire risk for both case study locations, compared with their respective state's ranks. According to this data compiled by Headwater Economics (2021), wildfire likelihood here is assessed as the probability of a particular location experiencing a wildfire in any given year. This likelihood is based on fire behavior modeling and simulations of possible fire ignitions, but not intensity. Populated areas in Nevada County have, on average, greater wildfire likelihood than 72% of counties in the state of California and 98% of counties across the United States (Headwater Economics 2021). Nevada County carries a relatively greater risk to homes than 79% of counties in the state of California and 96% of homes across the country (Headwater Economics 2021). Risk to homes is based on simulating the impacts from wildfire likelihood (probability) and wildfire intensity (impacts), although this data does not consider residential mitigation measures possibly undertaken in the counties. Populated areas in Larimer County, Colorado, have greater wildfire likelihood, on average, than 67% of counties in the state of Colorado and 68% of counties across the United States (Headwater Economics 2021). Larimer County,

Colorado, experiences greater risk to homes than 65% of counties in the state of Colorado and 74% of homes across the United States (Headwater Economics 2021).

Table 2: Wildfire Exposure

Percent of Total Homes (%)	Nevada County, California	California	Larimer County, Colorado	Colorado
Directly exposed	70%	15%	31%	26%
Indirectly exposed	30%	31%	44%	34%
Not exposed	0%	54%	26%	39%

Source: Headwater Economics. 2021. Economic Profile System, Natural Hazards. Accessed 31 March 2021. https://headwatereconomics.org/eps.

Table 2 presents further wildfire exposure data on risk to homes. According to data compiled by Headwater Economics (2021), about 70% of homes in Nevada County, California, are directly exposed to wildfire, such as from flammable vegetation. In comparison, about 31% of homes are directly exposed and 44% of homes are indirectly exposed to wildfires in Larimer County, Colorado, for example, from embers, or home-to-home ignitions. The data shows that relatively more homes are directly and indirectly exposed to wildfires in Colorado than in California (see Table 2). Of significance to community wildfire mitigation and defensible space efforts, about 19.4% of homes in Nevada County are seasonal or recreational, which reflect vacant and rental units, compared to 4.4% in Larimer County, Colorado (Headwater Economics, 2021).

Table 3: Potentially Vulnerable Populations

Percent of Total Population, 2019 (%)	Nevada County, California	California	Larimer County, Colorado	Colorado
Population change (2010-2019)	1.1%	7.2%	18.4%	14.8%
Families in poverty	7%	10%	5%	7%
People over 65 years of age	26 %	14%	15%	14%
People with disabilities	14%	11%	10%	11%
People with language barriers	1%	10%	1%	3%

*Source***:** Headwater Economics. 2021. Economic Profile System, Natural Hazards. Accessed 31 March 2021. https://headwatereconomics.org/eps.

Nevada County's population has modestly grown in the past decade at the rate of 1%, with a current population of just under 100,000 residents (World Population Review 2021a). According to data compiled by Headwater Economics (2021), Nevada County has a relatively higher percentage of older adults (26%) and people with disabilities (14%) compared to other counties in California. In contrast, Larimer County grew rapidly in the last decade (18.4%), had fewer people in poverty (5%), and with language barriers (1%) relative to the state of Colorado (see Table 3). Population growth in the WUI can be an important indicator of wildfire exposure and risk to homes. Also, people's susceptibility to wildfire, and associated hazards, can be based on their ability to prepare for, respond to, recover from, and adapt to compound hazards, such as experienced with the wildfire-pandemic interface in 2020. Socio-economically vulnerable populations are more likely to be affected by wildfires and compounding hazards because they may lack the financial resources, experience political and social exclusion, especially due to cultural and linguistic barriers, and have limited access to medical and personal care.

Table 4: Land Ownership

Land ownership	Nevada County, California	California	Larimer County, Colorado	Colorado
Total acres	**623,229**	**101,159,181**	**1,685,762**	**66,620,719**
Private lands	63.6%	47.5%	40.9%	56.9%
State lands	2.7%	2.8%	4.9%	4.9%
Federal lands	33.4%	47.4%	48.4%	35.9%
Forest service	30.6%	20.5%	38.4%	21.7%
BLM	2.7%	14.9%	1.6%	12.5%
National Park Service	0%	7.6%	8.4%	1.0%
City, County, Other	0.4%	1.7%	5.8%	0.7%

Source: Headwater Economics. 2021. Economic Profile System, Natural Hazards. Accessed 31 March 2021. https://headwaterseconomics.org/eps.

It is also relevant to examine the land ownership structures for each county relative to statewide trends to understand the significance of locally relevant fuel management strategies (see Table 4). Larimer County has a large share of Federal lands (48.4%) compared to Nevada County (33.4%). Of significance to how fuel mitigation activities were conducted during the pandemic in 2020, Nevada County has a large share of private lands (63.6%) while private lands in Larimer County account for less than half of total acres (40.9%). Of significance, while fuel mitigation activities drastically reduced on public lands during the pandemic, Nevada County experienced a surge in mitigation work on private lands. The community's unexpected progress with fuel mitigation during a pandemic shows how robust pre-existing local relationships can enable communities cope with compounding hazards in agile, responsive, and innovative ways.

Table 5: COVID-19 impacts by cases and deaths across time series

Time series	Total population (as of 2019)	Nevada County, California[1] 99,244 people		Larimer County, Colorado[2] 356,938 people	
	COVID-19	CASES	DEATHS	CASES	DEATHS
T1	**20 June 2020**	75	1	147	28
	20 July 2020	228	1	640	32
	20 August 2020	399	3	591	38
T2	**20 November 2020**	1,015	9	6,169	69
	20 December 2020	2,327	42	4,853	128
	20 January 2021	3,234	73	2,822	190
	20 February 2021	3,852	74	1,940	224
Total		11,130	203	17,162	709

While recovering from extreme wildfire impacts, both counties also experienced surging COVID-19 rates during the second time series interviews (see Table 5). For further comparison, between 20 June 2020–20 February 2021, Nevada County recorded 11,215 cases per 100,000 cases and 203 deaths per 100,000 cases, while Larimer County, Colorado, recorded 4,808 cases per 100,000 cases and 199 deaths per 100,000 cases (*The New York Times*, 2020). The data suggests that pandemic cases surged in weeks during after the wildfires across both case study locations.

Recovery from the wildfire impacts of 2020 and the COVID-19 pandemic are ongoing challenges for institutions and communities in both case study locations. There remains uncertainty around how these compound hazards will translate over the next years, especially for rural, aging, migrant, and low-income communities. Grounding policy, funding, research, and programs in such socio-economic and ecological data can present a comprehensive view of underlying risks and structural issues that will need to be addressed for communities to live with fire, amid compound hazards.

Characterizing the wildfire-pandemic interface

Findings from these two case studies are of wider significance because so many counties across the western states that experienced high wildfire risk also experienced high COVID-19 rate of transmissions, hospitalizations, and deaths in 2020. As of the time of this writing in June 2021, the severity of the wildfire-pandemic interface still holds true, especially as the highly transmissible COVID-

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[1] Nevada County, California, Coronavirus Dashboard. Last accessed 1 April 2021
https://nevcounty.maps.arcgis.com/apps/opsdashboard/index.html#/14d4460858214b358dfa3fae4cf33458
[2] Larimer County, Colorado, COVID-19 Dashboard. Last accessed 1 April 2021
https://www.larimer.org/health/communicable-disease/coronavirus-covid-19/larimer-county-positive-covid-19-numbers#/app?tab=cases

19 Delta variant establishes in counties nation-wide, and socially vulnerable and unvaccinated communities grapple with the evolving wildfire-pandemic interface. The findings presented for each location below also demonstrate why it will be important to engage in longitudinal case study approaches that follow community trajectories of preparing, responding, recovering, and adapting to compound hazards.

Social dimensions

Findings from Nevada County, California, and Larimer County, Colorado show that the social dimensions of the wildfire–pandemic interface were mainly experienced in the form of new methods of collaboration and modes of communication adopted by local institutions, community-based organizations, and volunteer networks. By early April 2020, workplaces had largely re-organized to work from home or remote locations and coordination heavily relied on phone calls, emails, and apps for virtual meetings, including Zoom, Google Meet, WhatsApp, and Facebook, among others. Local institutions and community-based organizations adopted a range of innovative information, communication, and outreach technologies, including new kinds of outreach through evacuation warnings, alerts, and notifications. However, the new reliance on technology meant that people who were not acquainted with or could not access these new modes of communication could get left out of community-wide wildfire preparedness and evacuation planning efforts, such as through virtual Town Halls. Especially in the initial months of the COVID-19 pandemic, virtual interactions were perceived as sub-optimal, especially by older adults, because they were not comfortable using virtual interfaces such as Zoom or Google Meet. These interfaces were also perceived to be one-way or top-down discussions. For example, webinar formats were most often adopted whereby local authorities would present on key issues but interactions with members of community have been limited to reading out some, not all, comments and questions from the chat or Q&A windows. In some cases, Zoom and similar virtual meeting formats, had the opposite effect of creating access for people who would not usually walk into a community wildfire preparedness day annual fair, or neighborhood work party. In some cases, these new modes of virtual communication led to wider outreach for people from more diverse backgrounds, particularly people who would otherwise be unable to attend meetings due to access and functional needs. Initially, it was found that older adults with medical conditions and disabilities found it challenging to routinely show up to virtual meetings in the general absence of connectivity infrastructure and assistive technology. However, the findings show that over the course of the year, some of these access issues eased and people's receptivity to virtual interactions such as Town Hall meetings generally increased.

Ecological dimensions

The ecological dimensions of implementing fuel reduction and forest restoration activities during the COVID-19 pandemic were marked by an overarching trend of urgency. The states of California and

Colorado considered fire hazard reduction work to be so critical in 2020 that forestry and fuel crews were defined as essential workers during the pandemic. This meant that most paid workers involved in fuels reduction projects continued their work uninterrupted. As a result, both case study locations experienced a surge of defensible space, home hardening, fuel reduction, and restoration work. Also, wildfires were generally perceived as a more significant concern than COVID-19. The perception was that COVID-19 rate of spread could be controlled by following personal hygiene and physical distancing guidelines whereas wildfire risk was perceived to be increasing at an insurmountable landscape scale. Deemed an essential activity, the implementation of vegetation management programs continued 'as normal' to a large extent, with COVID-19 related health and safety protocols in place. For example, on private lands in Nevada County, landowners employed a range of methods including thinning, pruning, and pile burning. Landowners worked alone, organized work parties with neighbors in small groups of four to six people or hired crews if available. In cases where large work parties were already planned prior to the spread of COVID-19, some drop-offs were seen among volunteers who self-identified as high-risk. In addition, fuel reduction along major transportation routes and highways remains a concern for evacuation planning. Findings across both case study locations confirm that more people accessed public lands for recreational purposes than ever before due to the ongoing pandemic. For future preparedness efforts, it will be important to understand how cultural norms, risk perceptions, and attitudes impacted wildfire preparedness and evacuation planning in the first year of the COVID-19 pandemic.

Public health dimensions

The public health dimensions of the wildfire–pandemic interface took on a new significance in 2020. While past concerns have centered around how wildfire smoke affects public health, in the past year communities in Nevada County, California, and Larimer County, Colorado, grappled with additional concerns around how wildfire smoke may exacerbate COVID-19 vulnerabilities and symptoms, especially for people with pre-existing medical conditions. Wildfire smoke can travel long distances thereby increasing the number of people exposed to particulate matter. Wildfire smoke can also linger for a long period, depositing particles and causing pollution within houses and structures. Wildfires can release air pollutants, toxins, particulate matter, and ozone gases. The composition of wildfire smoke depends on the size and intensity of the wildfire event and can vary greatly across geographies, with differential impacts across demographics. While the United States Environmental Protection Agency (EPA) and the Center for Disease Control (CDC) offer some guidance on wildfire smoke and indoor air quality, there is still insufficient guidance on environmental efficiency, structural mitigation, and retrofits (CDC 2020; EPA 2020). Communities currently do not have access to standards or guidance beyond buying air purifiers and creating a 'clean room', which can have considerable equity and access implications. In both case study locations, there were concerns around whether people would be able to safely distance and limit COVID-19 exposure in the event of an evacuation. In Nevada County, evacuees from the Jones Fire stayed with a family member, friend, or in a second home, while

following social distancing and safety protocols. No research participant from Nevada County reported staying at a non-congregate evacuation shelter or hotel. Evacuees stayed away from home for about three days, and the county was fully repopulated within seven days. This contrasted with Larimer County where the Red Cross coordinated a large non-congregate sheltering operation to place evacuees in hotels for long periods of four-six weeks, often in adjacent counties. Generally, wildfire evacuation sheltering across both locations did not mirror the complexity of the hurricane evacuation shelters in other parts of the United States. Further, the findings do not indicate confusion in public sentiment around the simultaneous public messaging for wildfires ('leave early') and COVID-19 ('stay at home').

Lessons for inclusive evacuation planning in Nevada County, California

Nevada County straddles the Sierra Nevada Mountain range. The foothills on the western side of the range are part of California's historic gold country with major communities including Nevada City and Grass Valley. The town of Truckee, located on the eastern side of the County, is adjacent to the Tahoe National Forest. Close to 64% of the County land is privately owned. Its history, access to the outdoors, and affordable cost of living make Nevada County a desirable place to live, work, and recreate.

Much like the rest of California, Nevada County experienced extreme wildfire impacts in 2020. The Jones Fire, which burned 705 acres, resulted in over 4,000 evacuations, and destroyed 21 structures (OES 2020). Wildfires will continue to pose a threat to Nevada County because nearly all County residents live in a high fire severity zone (NCOEM 2020). Simulations estimate about 70% of homes in Nevada County can be directly exposed to wildfire and 30% can be indirectly exposed (see Table 2). Currently, wildfire risk is managed through community-based organizations such as the Nevada County OES, Fire Safe Council, Coalition of Firewise Communities, and local media, which have a long history of augmenting local agencies in promoting awareness and mitigation efforts for County residents. In addition, recent advances in public communication such as through the online Ready Nevada County Dashboard have greatly improved outreach for alerts, evacuations, and emergency coordination.

Over the course of the two interview periods (June–August 2020 and November 2020–February 2021), concerns expressed by research participants in Nevada County generally centered around how institutions and communities would cope with wildfires during a worsening pandemic. Throughout the research period, research participants generally perceived wildfires as a greater threat than the COVID-19 pandemic, even though the latter posed many unknowns. Initial concerns with pandemic preparedness shifted over the months, as institutions and communities dealt with the aftermath of wildfire impacts and recovery (see Figures 3 and 4).

Nevada County's experience with the Jones Fire, documented below, shows how institutions and communities can iteratively work together for more inclusive evacuation planning within the context of compound hazards and cascading impacts.

Figure 3: California T1 key word map
(June – August 2020)

Figure 4: California T2 key word map
(November 2020 – February 2021)

The Jones Fire ignited on the morning of August 17, 2020, due to a lightning strike in downtown Nevada city, near the popular Jones Bar recreation area. The fire burned about 705 acres over 12 days, destroying 21 structures, and resulting in 4,000 evacuations. By the afternoon of August 17th, 2020, alerts went out to over 11,000 residents through CodeRED, an opt-in public alert system used in Nevada County to notify residents during emergencies. These alerts were received in English and Spanish, by text, email, landline, cell phone, and TTY. The east region of Nevada County, around the Truckee area, uses the Nixle alert system via the Everbridge Mobile App. Residents relied on local news media such as YubaNet for live coverage of the Jones Fire response. Residents also depended on 211 Connecting Point, a free service that connects residents with critical information before, during, and after a disaster, including information on accessing food, shelter, clothing, and recovery assistance. The public alerts were enabled by the timely launch of the online Ready Nevada County Dashboard, just days before the Jones fire ignited, which enabled the orderly evacuation and repopulation of over 4,000 people across the County. The dashboard was launched with assistance from 211 Connecting Point and social media accounts of Nevada County OES and local media, notably YubaNet. The recently adopted Hi-Lo sirens and evacuation tags also aided the efforts of law enforcement personnel conducting door to door checks as neighborhoods received mandatory evacuation orders that day.

During virtual public Town Hall meetings conducted earlier in the year, residents were encouraged to sign up for alerts well before the fires ignited across California. The adoption of these new information, communication, and outreach technologies have shown great efficacy, wide community adoption, and are likely to stay in use through 2021 and beyond. However, an over reliance on technology meant that many people who were not acquainted with or could not access these new modes of communication got left out of community-wide wildfire preparedness and evacuation planning efforts. The Hi-Lo siren system was important to keep those without cell, media, or internet connectivity alerted for evacuations.

In fact, wildfire impacts were most severely experienced by people with disabilities, older adults, and people from culturally and linguistically diverse backgrounds, especially in remote areas that lack support services, infrastructure, and connectivity. In particular, the Spanish-speaking population, and people with poor access to infrastructure and connectivity experienced barriers to receiving timely alerts and notifications and staying engaged with community-wide efforts on wildfire preparedness and evacuation planning.

Preparedness for both wildfires and the pandemic was particularly challenging for the Spanish-speaking population of Nevada County, California, because people were not acquainted with virtual formats and did not know where to find information in the absence of community engagement events. Seeing the lack of outreach efforts for Spanish-speaking populations, local community advocates adapted messaging and outreach to be sent out via WhatsApp group messages, which proved an essential source of real-time evacuation information for Spanish-speaking households during the Jones Fire.

Further, a survey of 445 people with disabilities found that 1 in 4 people report having a disaster preparedness plan (CFILC 2019). It has been shown that people with disabilities are two to four times more likely to be injured or die in a disaster and more likely to encounter barriers to accessing emergency services, including emergency notification, evacuation, sheltering, long-term recovery and have increased risk of institutionalization during and after disasters (Frederick et al. 2018; FREED 2020; NCD 2019).

Below, an excerpt reproduced from a blog post co-authored with a community disability advocate from Nevada County (see Lakhina et al. 2021b). This excerpt highlights the lived experience of people living with disabilities and wildfires during the COVID-19 pandemic.

Living with wildfires and disabilities: Reflections from a Community Disability Advocate

"I moved from the Sierra Friends Center in Nevada City to a downtown apartment in Grass Valley just six weeks before the Jones Fire started on August 17. I was working from home that Monday while closely monitoring updates through the day. As the fire started to advance, I felt increasingly unsafe. I live with a speech disability and use a wheelchair for mobility. My apartment was not in an evacuation order or warning zone, but I decided to leave. I don't drive, I didn't have a plan in place,

and I felt vulnerable. I called my friends for help. They had already evacuated earlier in the day. They decided to turn back and pick me up. With me in the picture and their two cats in the car, we decided that it would be simplest to get an Airbnb in Sacramento.

I did not consider accessing an evacuation shelter because I have a good network of friends across the Bay Area and prefer to rely on them. I consider going to a shelter a last resort. I can't imagine myself going to a shelter. Communication would be a big challenge. Activities of daily living (ADLs) would be a challenge. My friends know me and my needs, and I know (some) of their houses and know that they meet my access needs, or if they don't, that I can ask for the help I need.

After we stayed the night in Sacramento, I decided to relocate to a friend's house in Oakland. Although the evacuation orders had been lifted and Nevada County had been repopulated by the end of that week, I did not want to return home. I didn't want to return to Grass Valley only to feel vulnerable again. I was worried, what if a fire started again and I still didn't have a plan in place?

While I was in the Bay Area, I started developing an emergency evacuation plan. I also connected a team of people in the Bay Area on Slack. I am now in the process of connecting my Grass Valley evacuation team on Slack to assist with communication. In those weeks I took refuge in the Bay Area, I also spent a lot of time arranging for friends and friends of friends to go shopping for me and prepare food I could eat on my own. This time and effort took me away from my work. The pandemic made the situation more challenging. Due to health and safety precautions, I didn't want anyone in the Bay Area to physically help me eat. When I eat on my own, I can only physically eat certain foods, and they have to be prepared in a certain way. It was getting tiring. I returned home, three weeks after the Jones Fire had been contained.

On my return to Grass Valley, I have been dealing with the Public Safety Power Shutoffs (PSPSs). Some nights, I have felt completely helpless. I'm still working on my disaster preparedness plan. I'm networking in my immediate neighborhood as much as possible, but I don't know too many people right in this area. Soon after I got back to Grass Valley, I texted my upstairs neighbor and emailed an acquaintance around the corner. I never heard back. I will be following up with both.

At FREED, we have our hands full as far as emergency preparedness. We help consumers with personal planning, we provide backup batteries and hotel stays during PSPSs for people who use life-sustaining medical devices, and we work with the County and State Offices of Emergency Services to advocate for and coordinate the needs of people with disabilities during disaster planning, response and recovery. But there's only so much we can do. One of the things that we do to help people personally prepare for a disaster is to support people in identifying five people that can support them during a disaster. Something I hear a lot from our service staff is that a lot of people just don't have five people in their lives. If I am having trouble assembling an emergency team, I can only imagine what other people are going through.

Planning ahead, I'm identifying other friends' houses to be potential evacuation sites. In non-Covid-19 times, I travel frequently without my attendant, relying on the friends I visit to help me with the ADLs I do need help with. Currently, I only have one attendant (which itself is problematic and is something I'm working to change), and she has a family and multiple pets. So, evacuating with her

is not really an option. Even if I did, there would be a funding issue, as I am not allotted 24-hour care."

Source: This is an excerpt reproduced from a Northern California Grantmakers Blog, co-authored by members of this Working Group (Lakhina et al. 2021b).

The fire siege across Northern California, and in fact, the entire West, in conjunction with COVID-19 related constraints meant that access to regular resources and mutual aid networks, including regional and international crews, were no longer a reliable option to bolster regional operational resources, personnel, and equipment. Instead, local capacities were leveraged, and community care networks emerged stronger in many respects. Community-based organizations continued to rely on volunteers, yet the volunteer base significantly shifted over the months. In some places, the traditional volunteer base shifted from primarily older adults to younger home-based workers who made time to take care of basic needs for vulnerable households in their communities. The nature of care work itself shifted to allow for physically distant, virtual, and telecare interactions. This shift enabled some essential care and support programs to continue delivering meals and disaster preparedness messages to older adults and enabling people with disabilities to prepare for public safety power shutoffs. Yet, a general absence of personal connections and meaningful social interactions, especially among older adults, resulted in prolonged experiences of isolation amid compounding crises, resulting in mental health challenges.

> "People were getting really depressed … they were just so scared, they couldn't take it. This year, even though we had no close calls, I think there was some extra stress involved from COVID-19 that people were just uneasy about life in general and this pushed them to be a bit more negative and worried. In fact, some paranoid of what could happen with fire. And then in addition to that, there was a whole bunch of stress with the whole political situation. And nobody in our neighborhood got COVID-19 or knows anybody that got it, but still the stress is out there and I think that just made every other worry that they have amplified." (Research participant from Nevada County, California; Interviewed in December 2020).

Going forward, Nevada County's experience underlines the importance of relying on not just institutional mutual aid networks, but also investing in the potential of diverse community capabilities including neighborhood care networks.

Navigating compound hazards in Larimer County, Colorado

Larimer County sits on the northern end of the front range of the Colorado Rockies and is home to Fort Collins, the Arapaho and Roosevelt National Forests, and Pawnee National Grassland. Larimer County prides itself on easy access to parks, nature and, a high quality of life (Larimer County 2021). The County is home to a mix of forested and mountainous terrain, rangeland, farmland, and almost 370,000 residents as of 2021 (World Population Review 2021b).

Due to its natural habitat, Larimer County was ranked as having the second highest fire risk in Colorado due to the significant amount of development in the WUI (Smith et al. 2013). In past years, Larimer County's experiences with significant fires (e.g., High Park Fire, Hewlett Gulch Fire) has bolstered wide-spread collaboration among local communities, organizations, and government agencies, such as through the High Park Restoration Coalition and the Coalition for the Poudre River Watershed among others (CPRW 2021). These collaborations aim for equitable fire prevention, mitigation, and recovery and provide the foundation for reducing the vulnerability of County residents.

Over the course of the longitudinal research, research participant concerns generally centered around how institutions and communities would cope with wildfires in a pandemic. During the first round of interviews in June–August 2020, there was a shared perception that due to eastern Colorado's dry spell and the ongoing pandemic, the summer would pose some challenges and increased level of complexity in fire management operations. As a result, there was a significant focus on inter-agency preparedness and evacuation planning, with regular discussions around pandemic protocols, especially with regard to public sheltering and fire crew safety. However, at the time of the first interviews, no one was expecting three of the largest fires in the state's history.

Figure 5: Colorado T1 key word map
(June – August 2020)

Figure 6: Colorado T2 key word map
(November 2020 – February 2021)

Across the two rounds of interviews, before and after the fires, no perceptible shift of attitudes was observed regarding the pandemic (see Figures 5 and 6). In fact, like Nevada County, it was around the time of the second round of interviews, October–November 2020 onwards, that Larimer County experienced a surge in COVID-19 cases. In the case of Larimer County, there is a general perception

that many communities experienced surges in COVID-19 cases due to mass and repeated evacuations. In the second round of interviews, people and institutions were focused on recovering from the unprecedented impacts of wildfires on lives, property, and habitats. In addition, mental health issues were widely regarded as a concern in the aftermath of Colorado's wildfires, compounded by the widespread impacts of continued pandemic related business closures, unemployment, housing instability, and food insecurity.

In 2020, communities across Larimer County and adjacent counties experienced three of the most devastating wildfires in the state's history. The Cameron Peak Fire in 2020 was recorded as the largest in Colorado's history. On August 13th, the Cameron Peak Fire ignited in Poudre Canyon, west of Fort Collins. It burned for nearly four months scorching more than 200,000 acres, destroyed 469 structures, and resulting in large scale evacuations for Larimer and Jackson Counties (InciWeb 2021). The second largest fire in Colorado's history – the East Troublesome Fire – ignited on October 14th in Grand County but grew rapidly to also affect communities in adjacent Larimer County, causing mass and multiple evacuations. The third largest fire in Colorado's history – the Pine Gulch Fire – ignited from a lightning strike on July 31, 2020, about 18 miles north of Grand Junction, burning about 139,007 acres, but with no recorded deaths or damage.

This case study highlights the successful evacuation of Estes Park, an incorporated town in Larimer County, Colorado. The case demonstrates the importance of conducting simulations for evacuation planning, developing modes of agile inter-agency coordination across county boundaries, and tapping the potential of community support networks.

Estes Park can have a high day time and seasonal population. It receives a steady flow of visitors due to its pristine location along the Big Thompson River and Rocky Mountain National Park. Estes Park has a population of 6,426 (as of 2019), with a median age of 59 and a poverty rate of 13.5%. According to the 2019 data, 36.9% persons in Estes Park are over 65 years; 11.6% Latino; and 10.3% persons foreign born; 12.2% with a disability; 90.2% households have a broadband internet connection (U.S. Census Data 2019). A significant part of Estes Park is in the wildland-urban interface. Access to many properties within this zone is limited to narrow dirt and dead-end roads.

In recent years, Estes Park has frequently been selected for scenario planning and tabletop exercises such as the Threat, Hazard Identification, and Risk Analysis (THIRA) program (FEMA 2020) due to its high exposure to flood, fire, and ice storms, compounded by social vulnerability indices that reflect an aging and migrant population. After the devastating 2016 Gatlinburg Fires in the Great Smoky Mountains National Park, simulations were conducted to help plan for the evacuation of Estes Park. A fire like the Cameron Peak Fire had already been anticipated. So, in mid-September 2020, as the Cameron Peak Fire expanded southwards, local agencies were prepared to evacuate Estes Park.

However, it was the fast moving East Troublesome Fire that eventually caused Estes Park to evacuate on October 22nd, 2020. Moving fast across the continental divide the East Troublesome Fire forced evacuations in Rocky Mountain National Park and Estes Park. Within hours, an unexpected snowstorm significantly slowed the Cameron Peak and East Troublesome fires but made the roads hazardous and inaccessible.

About 6,000 people were evacuated out of Estes Park in a phased approach with real-time cross-boundary communications between Grand County, Boulder County, and Larimer County. Alerts were sent using the Everbridge system, a reverse 911, that automatically calls landlines but requires opt-in for cell phones. In some neighborhoods, law enforcement also went knocking door to door to ensure people had received the notifications and were preparing to leave. Local evacuation efforts were reported to have been greatly enabled by evacuee transportation and sheltering coordination from the Red Cross.

> "It comes down to those relationships built ahead of time because a lot of us knew one another. I think that's why things went really smoothly. We knew who to call. We knew who to contact and get all that moving, but the fact that nobody got hurt, there was not an accident that happened. It's just pretty phenomenal with that whole Estes Park situation." (Research participant from Larimer County; interviewed in December 2020).

United Way's 211 program assisted people with diverse access, functional, and linguistic needs by calling ahead of the evacuation warnings to ask if people needed help evacuating and offered to connect them with local emergency management services for emergency transportation and shelters. As the cold snap set in that week, many people who stayed back helped their evacuee neighbors by regularly checking on their homes and in many cases turning on the heat to prevent water damage from the likelihood of burst pipes.

There were multiple and repeat evacuations, and in some cases, people had been evacuated three or four times. With only three ways out of Estes Park – to the South, East, and West – emergency operations teams were constantly re-mapping routes as the fires closed in. Evacuees were often sent 60 miles away to a hotel. Evacuees were sometimes not greeted by Red Cross volunteers as they arrived in far flung hotel shelters. There was a general perception among our research participants that the sheer number of evacuees and repeat evacuations contributed to increased COVID-19 transmission. At the county level, Larimer County reported less than half as many COVID-19 cases as Nevada county per hundred thousand residents during the study period. However, the mortality rate was very close to the same, 205 per 100,000 in Nevada County and 199 per 100,000 in Larimer County (see Table 5).

While there is no tracing data to support the general perception that evacuations increased the rate of COVID-19 transmission for the community of Estes Park, included below some anecdotal findings:

> "… prior to the evacuation, I think there were maybe a total of 70 confirmed COVID-19 cases between March and the beginning of October. A week and a half after, folks came back once the evacuations were lifted, there was a 100 cases within two weeks. So you know, and I know emergency managers have been concerned about this and I mean even FEMA was talking about it more on the hurricane side for shelters. But yeah, the evacuations definitely increased COVID-19. I think they increased COVID-19 transmissions because people in Estes have been pretty careful, for the most part. And I think it's human nature. You're evacuated out. So, your life is completely up ended. Now get put to a hotel. And you're eating at restaurants or hotels and your friends and you need human contact so you kind of forget about the thing that's been going on since February, March, and you're living in the moment. And I think that's where a lot of transmissions occurred. Not intentional, but as a byproduct." (Research participant from Larimer County; interviewed in December 2020).

Many evacuees could not return home to Grand County and Larimer County after the fires and remain displaced. Employers shut down local businesses due to compounding impacts from the pandemic and then wildfires, leaving employees without employment and housing. Currently, there is no monitoring that tracks where evacuees may have relocated after the 2020 wildfires.

However, as outlined above, useful lessons were learned from the Estes Park experience in 2020 that can be applied to wildfire preparedness and evacuation planning in 2021, and beyond. In particular, learning from the gaps in information and alerts experienced by Estes Park's Spanish speaking population, Larimer County, through the Larimer Connects initiative, is now working with community hubs to make alerts more accessible and functional to people with disabilities and from culturally and linguistically diverse backgrounds.

SECTION IV: CONCLUSIONS

As a review of the literature in Section I–*Overview* shows, key issues regarding personnel safety, evacuation and shelter planning, fuel mitigation, and wildfire smoke have been largely discussed in silos so far. However, as Section III–*Findings* shows, institutions and communities do not experience compound hazards in silos or as singular issues. Instead, findings from Nevada County, California and Larimer County, Colorado, show the many ways in which institutions and communities will likely experience long-term and wide-ranging impacts from the wildfire-pandemic interface.

In conclusion, this section shows why, going forward, living *with* fire amid compounding hazards will require policy, research, and funding to converge around a better understanding of at least three interrelated dimensions (see Figure 7):

1. **Social dimensions** can be characterized by the robustness of a) local relationships, b) community infrastructure, and c) adaptive capabilities, including access to sustained funding and institutional support for community-led efforts.
2. **Ecological dimensions** can be characterized as the sustainable management of a) fuels, b) forest and watershed health, and c) carbon emissions.
3. **Public health dimensions** can be characterized by the effective management of a) air quality, b) COVID-19 long-haul and related safety protocols including equitable access and availability of personal protective equipment and vaccines, and c) mental health.

This framework is not proposed as a singular or final solution. It is hoped that the framework will enable convergence efforts to holistically address the evolving wildfire-pandemic interface in inclusive, just, and equitable ways (Lakhina et al., 2021a). The evolving wildfire–pandemic interface in 2020-2021 has presented a clear need for a convergence approach towards reducing disaster losses and promoting collective well-being. A convergence approach can be defined as a problem-focused and solutions-based approach with an emphasis on producing knowledge and actions by transcending disciplinary and organizational boundaries to address pressing social, economic, and environmental challenges (NSF 2018; Peek et al. 2020; Lakhina et al. 2021a).

Adopting a convergence approach across disciplinary and policy actions will be important as communities cope with compound hazards, such as, the COVID-19 pandemic, wildfires, lingering smoke, PSPSs, housing instability, food insecurity, racial injustice, and social isolation in 2021 and beyond. Drawing on the emerging body of research and policy reviewed in the previous sections and learning from the two case study locations – Nevada County in California, and Larimer County in Colorado, this section presents the remaining gaps in knowledge and implementation. Insights into the evolving wildfire-pandemic interface can offer some pathways to addressing systemic risk governance, resource allocations, and community-centered collaborations, as communities cope with compound hazards in 2021 and beyond.
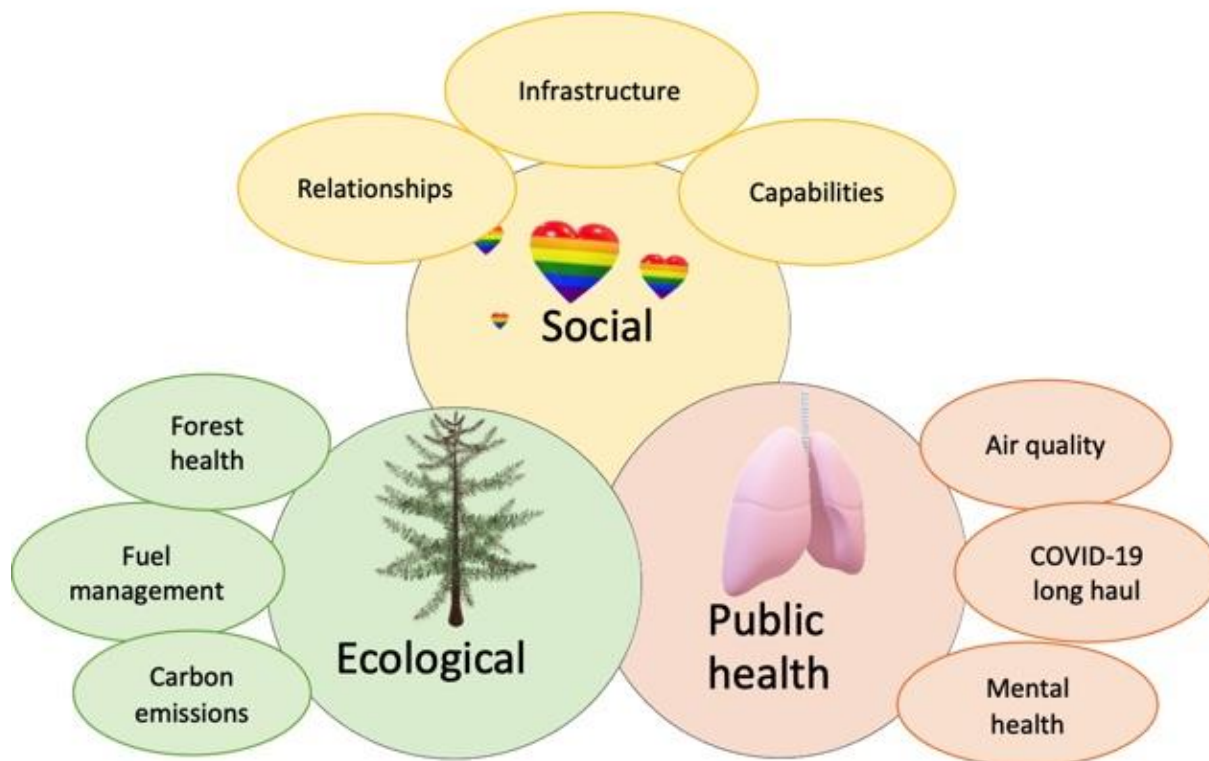
Figure 7: The wildfire–pandemic interface: Social, ecological, and public health dimensions

1   Social dimensions

Addressing the social dimensions of the wildfire-pandemic interface will require developing robust local relationships, community infrastructure, and adaptive capabilities, will include access to sustained funding and institutional support for community-led efforts, including non-profits, community-based organizations, and neighborhood volunteer networks.

Relationships

The wildfire–pandemic interface was most severely experienced by people with disabilities, older adults, and people from culturally and linguistically diverse backgrounds, especially in remote areas that lack connectivity, support services, and community infrastructure. A general absence of personal connections and meaningful social interactions due to COVID-19, resulted in prolonged experiences of isolation and resulting mental health challenges for many. Institutional and community experiences from the past year have shown the importance of investing in multi-scalar relationships, and especially, the importance of developing trust and care in local relationships. Going forward, it will be important

to invest in developing local relationships through a variety of meeting 'places' including virtual interactions.

Infrastructure

The wildfire-pandemic interface has emphasized the importance of maintaining well-resourced community infrastructure, including for safe and effective evacuations, and continued access to power especially for those who use electricity powered life-support equipment. In terms of understanding emerging community infrastructure needs, future efforts should include public health messaging within wildfire risk reduction outreach and awareness materials, including hardening homes for smoke and ash, which can linger for years in built structures. Finally, many states across the United States are currently prioritizing healthy buildings in their COVID-19 recovery plans, to assist the process of reopening safely. These initiatives present a unique opportunity to improve indoor air quality in ways that protect people, especially children, older adults, and people who live with immune-compromised systems, from wildfire smoke particulate matter and airborne infectious disease transmission.

Capabilities

The wildfire-pandemic interface has revealed why bolstering adaptive capabilities, not just suppression and response capacities, will be important for equitable adaptation and mitigation outcomes. While the focus thus far has been on augmenting the suppression and response capacity of fire and emergency personnel, 2020 revealed an urgent need for engaging and partnering with diverse community capabilities, including Indigenous land management practices and the knowledge and skills of migrant and incarcerated workers. Going forward, it will be important to understand how the wildfire–pandemic interface has affected the adaptive capabilities of communities and offer appropriate policy and program safety nets. This will require an in-depth understanding of changing poverty rates, identifying pockets of 'hidden poverty', including number of resource dependent households in the WUI, monitoring public health indicators, tracking data on displacement, migration, and rebuilding. Undertaking a convergence approach, such data can be open-source and accessible, with a view to inform the development of more responsive policy and programs.

2   Ecological dimensions

Addressing the ecological dimensions of the wildfire-pandemic interface will require the sustainable management of forest and watershed health, fuels, and carbon.

Forest and watershed health

Recent experiences of severe wildfire impacts have shown why it is important to pay attention to wildfire's wide-ranging and long-term impacts on forest and watershed health. Wildfires can increase soil erosion and deposit sediment loads in surface waters, which can lead to compromised infrastructure, increased need for treatments, including the use of disinfecting materials, which can be toxic. Wildfires can also release volatile organic compounds in water systems, affecting potentially

millions of people across county and even state boundaries. Going forward, the overarching challenge will be to sustainably manage the health of forests and watersheds to restore ecosystem infrastructure for future generations. Maintaining fire adapted forests and watersheds will also fulfil the goal of enabling communities to adapt to climate change by engaging in circular nature and forestry-based economies.

Fuel management

In the past year there has been widespread acknowledgement of the need to manage fuel overloads in forests across the western United States. An optimal fuel management strategy will need close cooperation and coordination between Federal, State, Local, Tribal, and private landowners. The National Prescribed Fire Act of 2020 makes policy and legislative progress by calling for serious investments in fuel management, increasing the pace and scale of prescribed burning, creating a skilled prescribed burn workforce and continuous training and development that is accessible to students, the incarcerated, and migrant workers, and streamlining smoke regulations to address public health impacts, especially during the pandemic. Consistently implementing such efforts could greatly contribute to sustaining effective fuel load reduction and recreate communities with forest-based technologies for heating, smart sensing, and circular economies.

Carbon emissions

In past years, wildfires have increasingly run through agricultural and ranch land in the WUI. Soil and vegetation can release contaminants and result in poor water absorption and drainage. Agricultural farms can also be affected by debris and ash deposits which often contain toxins. Wildfires also regularly destabilize soil and sediments, particularly along slopes, resulting in flash floods, mudslides, and debris flows that often result in further loss of life and property. Carbon emissions and toxicity from WUI fuels can have long-term implications on forest and watershed health, social and economic wellbeing, and public health. A future challenge will be to monitor and manage carbon stocks in and around WUI communities.

3   Public health dimensions

Addressing the public health dimensions of the wildfire-pandemic interface will require the equitable management of air quality, COVID-19 related health and safety protocols including personal protective equipment, vaccines, and long-haul symptoms, and mental health.

Air quality

Around the world, building-related interventions have been shown to reduce the spread of many airborne infectious diseases (Lancet Commission 2021). Many states across the United States are prioritizing healthy buildings in their COVID-19 recovery plans, to assist the process of reopening safely. These initiatives present a unique opportunity to improve indoor air quality in ways that protect

people, especially children, older adults, and people who live with immune-compromised systems, from wildfire smoke particulate matter and airborne infectious disease transmission. Wildfire smoke mitigation can also become part of home hardening guidance put out to homeowners, such as the recently released Wildfire Home Retrofit Guide (Restaino et al. 2020). In the absence of current standards and guidance, homeowners can engage in preventive actions by repairing or replacing doors, windows, and vents with major air leaks, and using caulk, weather-proofing tape or sealants to fill in small openings. Older homes may be more susceptible to these types of problems, while newer homes are generally built more tightly (Sac Bee 2021). Finally, preventive actions that contribute to healthy homes and community well-being outcomes could be subsidized, including clean air rooms in community infrastructure, and respiratory protective equipment including personal respirators and air filters to socio-economically disadvantaged neighborhoods, similar to PG&E's initiative of providing battery power backups. It will also be important to implement community-centered resilient air quality monitoring networks, especially in communities at high risk of wildfire impacts and vulnerable demographics. The current framing only protects a segment of the population's assets, it does not contribute to strengthening people's adaptive capabilities. Such inequity in policy framings and incentives can have visceral consequences for intergenerational health and well-being outcomes.

COVID-19 and long-haul

Even as the United States gradually reopens after 14 months of COVID-19 related shutdowns as of June 2021, thousands of people continue to experience COVID-19 related long-haul illnesses and disabilities, including chronic fatigue (Davis et al. 2020; Yong 2020). It will be important to assess how wildfires could worsen these ongoing public health impacts from the pandemic, and how people's experiences of COVID-19 related health impacts will continue to affect people's ability to prepare for wildfire mitigation and evacuation planning in 2021, and beyond. Caring for the entire range of COVID-19 long-haul illnesses will require potentially rethinking transportation, sheltering, personal and medical care, and food arrangements for COVID-19 long-hauler evacuees. Finally, it will be important to continue to have COVID-19 contingency plans that account for the possibility of continued COVID-19 mutations and community transmission during wildfire events. Such contingency plans will ensure that people have equitable access to vaccinations, clean air rooms, power back-ups, PPE, meals on wheels, relevant and accessible emergency alerts, transportation for early evacuation, and continued access to personal care even during an evacuation.

Mental health

While further longitudinal research is needed to understand the long-term mental health impacts of populations exposed to cascading disasters, our research confirms that the COVID-19 pandemic worsened mental health outcomes in 2020. Broadly indicative of mental health outcomes are incidences of increased depression, anxiety, increased psychiatric concerns, grief, trauma, and stress due to compound crises, social isolation, and lack of regular psychosocial support. Grief and trauma are

globally well-documented experiences among evacuees, especially for people who have experienced successive disaster evacuations, such as from wildfire, flooding, and landslides, and loss of family, friends, pets, and property. Mental health support and spiritual care will be an urgent need for all communities coping with compound hazards in 2021 and beyond. Made worse by social isolation due to COVID-19, psychosocial support will be particularly important to offer in schools, care facilities, and places of worship to care for the mental health of children, young adults, older adults, people with disabilities, and marginalized people from diverse cultural and linguistic backgrounds. Future studies can examine how children and older adults who have experienced compounding crises, and vicarious grief or secondary traumas, have practiced care for self, family, and community.

The next section identifies key recommendations that can apply to locations across the western United States, and perhaps, globally. It is hoped these recommendations can guide the development of more collaborative, agile, and responsive strategies for wildfire risk reduction to enable broader social, ecological, and public health and well-being outcomes.

SECTION V: RECOMMENDATIONS

The western United States is likely to experience another severe wildfire season in 2021. Even as communities get vaccinated over the next months, and the pandemic seemingly recedes, there remains uncertainty around community preparedness and evacuation planning in a pandemic.

It will be important to comprehensively prepare the 'whole of community' for the evolving nature of the wildfire-pandemic interface (Burke et al. 2020). Recommendations listed here will also be useful for future pandemics, that are unfortunately, likely to occur.

Moving forward, policies, programs, and research will need to converge around a better understanding of social, ecological, and public health dimensions to address the evolving wildfire-pandemic interface in inclusive, just, and equitable ways.

Fortunately, important lessons can be applied from the past year. Based on longitudinal research (June 2020 – February 2021) conducted in Nevada County, California, and Larimer County, Colorado, this research report recommends 22 priority actions across nine areas and three cross-cutting dimensions for communities working to reduce wildfire risk while recovering from the COVID-19 pandemic.

SOCIAL DIMENSIONS

Relationships:
1. Continue to rely on asynchronous collaboration tools and virtual modes of communication to strengthen multi-scalar relationships between institutions, communities, and service providers.
2. Redesign community outreach and local awareness campaigns in ways that people from diverse access, functional, and linguistic backgrounds can participate in community preparedness days, fuel reduction treatments, prescribed burn trainings, and evacuation drills.
3. Engage early with people who are likely to require assistance in interpreting alerts and safety messages, creating defensible space, preparing for Public Safety Power Shutoffs, planning for safe evacuations, accessing vaccinations and personal protective equipment (PPE). Develop systems that include methods of notification about wildfire evacuation not contingent on internet, phone or media connectivity such as Hi-Lo sirens.

Infrastructure:
4. Regularly clear and maintain evacuation routes, roads, and highways.
5. Ensure structural integrity of essential infrastructure and utilities, especially water and electricity.
6. Continue to implement COVID-19 related health and safety protocols in community centers, hotels, fair grounds, and shelters, including pet and animal shelters.

7. Monitor housing market, poverty rates, including 'hidden poverty', displacement, and migration trends as communities and businesses adapt to the fallout of last year's wildfire-pandemic interface to identify where infrastructure needs retrofits and improvement.

Capabilities:

8. Formalize partnerships, ensure interoperability, and conduct regular county-wide trainings with local and adjacent communities, institutions, utilities, transport, and health care providers. Anticipate fast changing conditions, including COVID-19 transmissions, and have contingency plans in place.
9. Adopt community-centered and collaborative wildfire management arrangements that draw on local and indigenous environmental knowledge and build on diverse community capabilities, including, the experiences of incarcerated and migrant workers.
10. Ensure contingency stocks of PPE, in case of continuing COVID-19 transmission, and the spread of other infectious viruses.
11. Prepare go-bags and practice 'Ready, Set, Go!' with households and neighborhoods, including all of community.

ECOLOGICAL DIMENSIONS

Forest health:

12. As COVID-19-related fiscal impacts continue into 2021, provide Federal, State, and local assistance to communities and landowners to manage privately owned forestland. Communities could consider setting up forest health /prevention funds and look to private capital and philanthropic funds to undertake large forest management projects.
13. Adopt wider implementation of community-centered environmental sensing networks for air, water, soil quality monitoring before, during, and after wildfires, and secondary hazards.

Fuel management:

14. Provide financial and training support to complete defensible space work on private land in physically distant ways. In the absence of local crews, create incentives for volunteers to help households in need of assistance, including mobile home parks.
15. Continue fuel management activities, including thinning and prescribed burn trainings, on public and private lands, following local health and safety protocols.

Carbon emissions:

16. Create community fuel breaks along residential, agricultural, and ranch lands to reduce WUI-related carbon emissions; protect soil and agricultural land from smoke, debris, and contaminants that may affect water and harvest quality.

PUBLIC HEALTH DIMENSIONS

Air quality:

17. Develop new standards to protect structures from wildfire smoke impacts, including measures to improve ventilation, circulation, and filtering of indoor air, especially in schools, health facilities, and care homes.
18. In the absence of current standards, homeowners can repair or replace doors, windows, and vents with major air leaks, and use caulk, weather-proofing tape or sealants to fill in small openings.
19. Subsidize the instalment of clean air rooms, and make respiratory protective equipment including personal respirators and air filters easily accessible in socio-economically disadvantaged neighborhoods. Protect the health of seasonal farm workers by making vaccinations and PPE easily accessible. Provide specialized services to residents in mobile home parks and people living in informal housing or on the streets.

COVID-19 long haul and disabilities:

20. Ensure people with COVID-19 long haul and disabilities, have equitable access to vaccinations, clean air rooms, power back-ups, PPE, meals on wheels, relevant and accessible emergency alerts and notifications, transportation for early evacuation, and continued access to personal care even during an evacuation.

Mental health:

21. Ensure people from diverse cultural and linguistic backgrounds have equitable access to mental health and spiritual care support near where they live/ through culturally relevant tele-health providers.

22. Conduct mental health campaigns to encourage people, especially children and older adults, to process their grief and trauma by journaling, drawing, and sharing experiences and concerns with a mental health worker, therapist, or trusted circle of care.

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APPENDIX A

T1 Interview Guide
(June – August 2020)

T1 INSTITUTIONAL GUIDE

In the first round of semi-structured interviews, conducted between June – August 2020, four key questions were asked of institutional representatives from fire management, emergency management, water and electricity utilities, and state/ local organizations focused on preparedness:

1. Could you talk about how your agency/ organization is continuing work during this pandemic? What kind of work is currently being undertaken, and what kind of work has reduced or stopped due to health and safety concerns?

   Sub-questions/prompts:

   - What have been some of the key challenges in implementing your work?
   - Any thoughts about what these challenges might mean for future risks?

2. Could you talk about how your agency/ organization is keeping staff, workers and volunteers safe? You could talk about issues relating to safety guidance, field protocols, and access to personal protective equipment.

   Sub-questions/prompts:
   - What protocols and strategies are currently in place to keep staff/volunteers safe?
   - What kind of PPE are staff, workers and volunteers currently using and do you think it is keeping them safe from COVID-19?
   - What are the health concerns around smoke, in the particular context of COVID-19?
   - How are field teams/ volunteers keeping safe and working together?
   - How do you think in-person training and workshops may be organized in the near future?

3. In what ways do you think community wildfire preparedness and evacuation planning is changing due to the pandemic?

   Sub-questions/prompts (these will vary depending on agency, please see underlines for relevance):
   - What household mitigation/preparedness actions do you see still happening? What is different?

- How about preparedness needs within health care facilities (e.g., hospitals) and assisted living facilities?
- What about schools and child-care facilities?
- How are emergency alerts currently reaching vulnerable and marginalized populations, such as those with language, access and functional needs?
- What is being done differently in planning for evacuation and shelters during this pandemic?
- What have been the key challenges?

4. Looking into the future, what are some innovative or alternative ways to address wildfire mitigation, preparedness, and evacuation planning efforts?

       Sub-question/prompts:

- What are the fundamental shifts - organizationally and within communities – that will be required for wildfire resilience?

T1 COMMUNITY GUIDE

During the same period, between June – August 2020, similar questions were posed to community representatives from Firewise communities, community-based organizations, small business owners, and volunteer networks:

1. Could you talk about how your community/ association / Council, is continuing work during this pandemic? What kind of work is continuing, and what kind of work has been reduced or stopped due to health and safety concerns?
          Sub-questions/prompts:

   - What have been some of the key challenges in implementing your community's work?
   - Any thoughts about what these challenges might mean for future risks?

2. Could you tell us a bit about how you are trying to keep safe from wildfires and COVID-19? What are some of the things you're doing – personally, as a family and in your community, to prepare for wildfires and a possible evacuation this summer?

          Sub-questions/ prompts:

   - What kind of PPE are you currently using? and do you think it's keeping you safe?
   - What are the health concerns around smoke, in the particular context of COVID-19?
   - What kind of information would help you make an informed decision about if and when to evacuate?

- If you receive a pre-evacuation alert, are you most likely to leave early or wait and watch how things develop? Would you know where to go – do you know which shelter/s?
- Who are you most likely to ask for help during an evacuation?
- Would you consider staying to defend your property?
- What do you think could be your greatest challenge in organizing a safe evacuation?
- What kinds of personal protective gears and other health and safety provisions would you like to see available in the evacuation and recovery shelters?
- What do you think could be the greatest challenge for evacuees trying to return home after a wildfire?

3. In what ways do you think community wildfire preparedness and evacuation planning is changing due to the pandemic?

   Sub-questions/prompts:
   - What household mitigation/preparedness actions do you see still happening? What is different?
   - In this time of physical distancing, how are residents being assisted with evacuation planning and preparedness activities differently?
   - Do you think preparedness information and alerts are reaching people with language, access or functional needs in your community? Who do you think is being left out?
   - How do you think schools and hospitals, assisted care facilities, will need to prepare differently this year?
   - What do you think is the greatest challenge in preparing your household and community for wildfire during this pandemic?

4. Looking into the future, what do you think could be some innovative or alternative ways to address wildfire mitigation, preparedness, and evacuation planning efforts?

   Sub-question/prompts:

   - What are the fundamental shifts - organizationally and within communities – that will be required for wildfire resilience?

APPENDIX B

T2 Interview Guide
(November 2020—February 2021)

T2 INSTITUTIONAL GUIDE

1. Could you talk about how your agency/ organization responded to the fire siege of 2020? What was the extent of your response and how did it go?

   Sub-questions/prompts:

   - What was done differently?
   - What were your key challenges?
   - What worked well?

2. There were a number of highly dynamic scenarios to respond to – mass evacuation, smoke impacts, Public Safety Power Shutoffs, and COVID-19 related concerns – how did you keep your staff, workers and volunteers safe?

   Sub-questions/prompts:
   - Did your safety guidance and field protocols work well? Are any modifications expected to your protocols based on experiences this year?
   - Did staff, volunteers and community/ clients have sustained access to personal protective equipment?
   - What were some of the health concerns around smoke, in the particular context of COVID-19? How did staff and volunteers cope?
   - Were there any mental health issues and were any counseling services available to staff, volunteers?

3. What are the biggest lessons from this year? Especially with regard to how you worked with affected communities, including evacuees and people who have been displaced?

   Sub-questions/prompts (these will vary depending on agency, please see underlines for relevance):
   - What household mitigation/preparedness actions do you think really helped this year? What should households continue to focus on?
   - How did health care facilities (e.g., hospitals) and assisted living facilities fare this year?
   - What about schools and child-care facilities that did reopen?
   - Did emergency alerts reach vulnerable and marginalized populations, such as those with language, access and functional needs?

- How did evacuation and shelters fare, especially for people with access and functional needs? Did you see more or less people access shelters relative to previous years?
- What have been the key challenges?

4. Going into next year, what kinds of fundamental shifts will be required for wildfire resilience? How do you think we can become better adapted to *living with fire*?

   Sub-questions/prompts:

   - There's a clear focus emerging around mitigation and fuel management at scale, specifically, prescribed burning. How are you incorporating that in planning for next year?
   - Institutionally, what do you need to adequately address mitigation and fuel management?
   - Are there other areas we should be collectively focused on?

T2 COMMUNITY GUIDE

1. Could you talk about how your community/ association / Council coped with the fire siege of 2020? Tell us about your community's experience.

   Sub-questions/prompts:

   - How many people were evacuated? How many homes damaged? Are they rebuilding?
   - What were the key challenges, especially for people with access and functional needs?
   - What worked well from the community's perspective?

2. Could you tell us a bit about your/ clients' personal experiences? What are some of the things you did to keep safe from the wildfires, lingering smoke, PSPSs and COVID-19 this summer?

   Sub-questions/ prompts:

   - What kind of alert/ information helped you decide if and when to evacuate?
   - Did you know where to go? Which evacuation routes were safe?
   - Where did you take shelter/ evacuate to?
   - Did you stay, or consider staying, to defend your property?
   - What do you think was your greatest challenge in organizing a safe evacuation?
   - What kinds of personal protective gears and other health and safety provisions did you access/ need in the evacuation and recovery shelters?
   - What was the greatest challenge for evacuees trying to return home?

- How did you keep safe from smoke? Is your home weatherized? Did you buy air purifiers? What are you planning for next year in those respects?
- How did you deal with the Public Safety Power Shutoffs (PSPSs)?
- How have you dealt with any mental health issues in the community? Were you able to provide counseling?

3. What are the community's biggest lessons from this year, in terms of mitigation, preparedness, response and recovery?

   Sub-questions/prompts:
   - What household mitigation/preparedness actions do you think really helped this year? What should households continue to focus on?
   - How did local community-based organizations pivot and step up to respond to compounding risks in your community?
   - Do you think preparedness information and alerts reached people with language, access or functional needs? Who do you think was left out?
   - In this time of physical distancing, how did residents assist friends and neighbors with evacuation and sheltering? What was different this year in the community's response?
   - How do you think schools, hospitals, assisted care facilities, coped this year?
   - What do you think was the greatest challenge in preparing households and community for wildfires during a pandemic?

4. Going into next year, what kinds of fundamental shifts will be required for wildfire resilience? How do you think we can become better adapted to *living with fire*?

   Sub-questions/prompts:

   - There's a clear focus emerging around mitigation and fuel management, specifically, prescribed burning. How are you trying to plan for that in the community next year?
   - As a community, what do you need to adequately address mitigation and fuel management?
   - Are there other areas we should be collectively focused on?