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Community Adaptations to Wildfire Risk in Central Oregon, USA: an Empirical Study of Inclusionary Practices in Collaborative Wildfire Risk Mitigation

by

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ABSTRACT

Adverse impacts of wildfire in Western North America have become increasingly present through the 21st century, driven by landscape changes imposed by colonists in the 19th and 20th centuries. Community adaptations to wildfire will be necessary through the 21st century to restore landscapes and protect the safety and livelihoods of people who live in at-risk areas. Wildfire risk extends across countless environmental and social systems, and individuals have competing ideas about what constitutes that risk and how to best adapt to it. As resources are being allocated to community adaptations, important questions emerge about the values represented in the design of those adaptations. In this thesis, I empirically examine community adaptations to wildfire in Central Oregon in the United States to shed light on the processes of inclusion in collaborative management. Specifically, I explain how input from the public is incorporated into regional wildfire risk mitigation projects, and why some wildfire managers are more inclined than others to include public input in their project plans. I found that generally, projects are designed by wildfire management professionals based on their values and policy frameworks, but they design these projects to be tolerable by communities to avoid litigation. This structure for designing projects allows managers an amount of flexibility as to how they include public feedback in their projects. I found that different cultural perceptions about the nature of wildfire risk leads managers to include more or less public input in their project planning. I conclude that wildfire managers are leaving latent adaptive-capacity untapped by not deliberately including the public in the beginning stages of designing wildfire adaptation projects.

ACKNOWLEDGEMENTS

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INTRODUCTION

Wildfire in the American West: a history of land-use and wildfire regimes

Across Western North America, wildfire regimes have been changing over the course of the last century, bringing new attention to wildfire risk management. Several drivers have caused wildfire regimes to change, including anthropogenic climate change (Hanan et al. 2021), land-use change (e.g. Donovan et al 2020; Butsic et al. 2015), human encroachment (Chen and Yin 2022), and major changes to land management since colonization (e.g. Hanan et al. 2021). The American West is largely comprised of dry pine forests that have historically been subject to fuel-limited wildfire regimes, in which low-intensity fires burned frequently. These frequent fires burned forest litter and suppressed understory growth, rarely becoming intense canopy fires. This disturbance regime maintained a wide spacing between tree canopies and generally left mature trees unharmed (e.g. Stephens and Fulé 2005).

Prior to western colonization, Indigenous peoples of Western North America deliberately used fire to manage their environments, generate food, and celebrate culture. Their frequent burning cultivated variable forest structures, maintained biodiversity, and reduced wildfire risk (Boyd 1999). The forced displacement and cultural erasure imposed by western settlers over the last 200 years dramatically altered forest management (Norgaard 2019). Colonists in the late 19th and 20th centuries valued timber production, and subsequently established a fire suppression regime that changed forest structures and disturbance regimes in western forests. By suppressing every wildfire and implementing

plantation forestry, forests grew increasingly dense and homogenous, a substantial change from the sparse and heterogeneous structure previously maintained by Indigenous peoples. This new forest structure contributed to a spike in the number of high-severity wildfires (Zald and Dunn 2018; Evers et al. 2022). Beyond impacts to flora and fauna, the issue of wildfire in the West is especially relevant to humans today given the numerous socio-ecological impacts of wildfire and the extreme population growth that has occurred in the wildland-urban interface in the 21st century (Fischer et al. 2016; Hammer et al. 2009). Active land management and community adaptations to wildfire will be necessary to restore forest structure and ecosystem functions, protect human health, and maintain safe communities.

Wildfire policy in the United States: landscape treatments

By the end of the 20th century, in the face of consistently increasing costs of wildfire suppression, public policy on wildfire had shifted toward implementation of active management, namely using hazardous fuel reduction projects that reduce severe wildfire risk. As research into historical fire regimes and post-colonial landscape change developed, a greater understanding of fuel-limited wildfire regimes led scientists and legislators to propose the Community Protection and Hazardous Fuels Reduction Act of 1997. Although the bill struggled to gain traction and never passed out of its subcommittee, it laid the groundwork for the first major law emphasizing hazardous fuels reductions, the Healthy Forest Restoration Act of 2003. In addition to funding and mandating fuels reductions, this incentivized the local creation of community wildfire

protection plans (CWPPs), documents that guide local adaptations to wildfire risk. CWPPs and hazardous fuels reductions continue to play central roles in current wildfire risk mitigation efforts (e.g. Palsa et al. 2022). Broadly speaking, these active land management and community adaptation projects can be referred to as wildfire risk mitigation projects. Typically, these projects include hazardous fuels reduction (like mechanical thinning and prescribed fire), natural resource planning, homeowner actions (like creating defensible space and home hardening), community education, development planning, disaster planning, and more. In any given area, there are typically a variety of government agencies, nonprofit and private-sector organizations, forest collaboratives, and others who work in different capacities on these wildfire risk mitigation projects.

While the Healthy Forest Restoration Act of 2003 emphasized the importance of fuels reductions, the law lacked the funding to implement landscape treatments at the necessary pace or scale to reduce the costs of suppression and wildfire damages. In the face of still increasing suppression costs and damages due to increasingly severe wildfires, more recent policy has attempted to rectify the lack of funding for hazardous fuel reductions. For example, the Wildfire Crisis Strategy (ca. 2022) from the United States Forest Service ("USFS" or "Forest Service") seeks to dramatically increase the pace and scale of landscape treatments with an estimated cost of $50 billion over ten years (Brown and Cooper 2022) in conjunction with the Infrastructure Investment and Jobs Act (ca. 2021), which allocated over $3 billion to wildfire risk reduction, and the Inflation Reduction Act (ca. 2022), which directed an additional $1.8 billion to hazardous

fuels reductions. Along with the federal government, states are also making record investments in wildfire risk mitigation. In Oregon, the state legislature passed Senate Bill 762 in 2021 after a devastating wildfire season. This bill, colloquially referred to as the "wildfire omnibus bill," invested $220 million into wildfire risk mitigation.

Planning wildfire risk mitigation projects at the regional scale

Money has been one of the primary barriers to accomplishing the necessary scale of wildfire risk mitigation (North et al. 2015), but with the recent influx of funding, other barriers are worthy of consideration. For projects on federal lands, managers need to navigate ecological constraints (namely constraints due to habitat protected by the Endangered Species Act), timber quotas (which can complicate projects based on market rates and contractor capacity), state and federal regulations surrounding air quality (which can limit managers' ability to leverage prescribed fire because of the smoke produced as a byproduct), and concerns from local communities (which can cause projects to stall through litigation or other means [e.g. Jijelava and Vanclay 2018]).

Forest management is certainly a large component of wildfire risk mitigation, but homeowner and community actions like fire-proofing structures and creating defensible space are also important. On private lands, projects to develop adaptations to wildfire typically face cultural/political barriers like reluctant landowners paired with a lack of enforceable programs, as well as financial barriers (although programs for private lands are currently receiving a share of the funding influx). Wildfire managers, especially from

local fire departments, have for the last few decades focused on increasing homeowners' perceptions of risk to wildfire with the assumption that increased awareness of wildfire risk would lead to more fire-safe actions by landowners. On the contrary, McCaffrey (2008) concluded that elevated perceptions of risk may not lead landowners to engage in safer actions, and instead suggested that increased communication between landowners and professionals involved in wildfire management ("wildfire managers") may be a more effective route.

Most wildfire risk mitigation actions occur at the parcel-scale, but wildfires and associated impacts transmit across land and jurisdictional boundaries, so planning at the regional scale is necessary to mitigate wildfire risk. The growing diversity of people and organizations involved in wildfire risk mitigation is further increasing the need for collaborative, holistic wildfire management at a regional scale (e.g. Busenberg 2004; Miller et al. 2022). In regions across the Western United States, landowners and managers work with informal networks of other landowners, nonprofits, and government agencies to collaboratively manage wildfire risk based on collective, regional-scale environmental, social, cultural, and economic goals. Networks like this can be referred to as "social influence networks" (Bodin and Crona 2009; Fischer and Jansey 2017; Spies et al 2018; Friedkin 1991). In the context of wildfire management, I refer to them as "wildfire management networks." Research into how information about vulnerability, risk, and adaptation flows through these networks is ongoing (Fischer et al. 2016; Fischer, Spies, and Bolte 2011), and several of the central questions emerging from the

literature fall at the intersection of wildfire management professionals and other stakeholders at large: how do relationships between professional wildfire management practitioners and non-manager stakeholders affect managers' decisions about where, when, and how to plan and implement wildfire risk mitigation projects? Are some managers more likely than others to include public input in regional wildfire risk planning, and why?

Research questions and methods

In Paper I, I address the lack of clarity about how wildfire management networks include input from the public when designing wildfire risk mitigation projects. I interviewed over a dozen professionals involved in wildfire risk mitigation in a wildfire-prone region of Central Oregon in the United States, and I present their perspectives about how input from the public impacts their work. I frame the study through collaborative governance theory to characterize the roles of various stakeholders and how they influence collaborative processes. I conclude with recommendations for managers to reshape public engagement in community wildfire adaptations to increase the region's adaptive capacity. In Paper II, I highlight cultural viewpoints that impact wildfire managers' attitudes toward inclusion of the public in management planning. Using data collected from two surveys of the Central Oregon wildfire management network, I developed a novel framework for representing the role of cultural perceptions of wildfire risk in management priorities. I compare the utility of that framework with a commonly used framework for representing cultural perceptions of risk. I conclude with a discussion

about how culture might impact participatory processes in natural resource management using the framework of collaborative governance theory.

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Paper I: Building Wildfire-Adapted Communities: an Assessment of Current Practices for Including Public Input in Regional Wildfire Risk Mitigation in Central Oregon, USA

ABSTRACT

Organizations involved with natural resource management in the United States commonly make decisions based on "the best available science," yet management is a social process based largely on values. In the Western United States, networks of practitioners collaborate to cultivate "wildfire-adapted communities" in response to growing risk from wildfire, but communities are diverse and can have different values around wildfire risk and adaptation, raising questions about who is included in decision-making processes. I apply collaborative governance theory to regional wildfire risk mitigation efforts in Central Oregon, a fire-prone landscape, to assess how input from communities is currently being incorporated into wildfire management decisions. I interviewed wildfire managers from federal land management agencies, local fire departments, NGOs, and the private sector to better understand their interactions with the public and the effect on their management decisions. I found two mechanisms for including public input in wildfire management, the first of which includes formal processes like those mandated by federal law, but the influence of this mechanism is limited. The other mechanism is more impactful, and centers on organizations prioritizing the maintenance of public trust to avoid litigation, which can halt projects. Managers do this through education initiatives as well as by designing projects to minimally disturb the public. I conclude that their current practices have yielded acceptance from communities,

but raise questions about whose values are reflected in regional wildfire adaptations, and that managers are leaving potential adaptive capacity untapped by inadequately involving the public in wildfire management decisions.

1. INTRODUCTION

1.1. Values-based natural resource management

In the United States, those working in natural resource management are generally tasked with designing policy and projects around the best available science. Conversely, the idea that natural resource management is reflective of human values is not new. Ostrom (1990) identified principles for successful resource management, including the ideas that most affected individuals should have a say in how resources are managed and that robust mechanisms for conflict resolution should be in place for when those individuals disagree. Several of Ostrom's principles could be viewed as having laid the groundwork for early study of socio-ecological systems, a framework conceived by Fikret and Berkes (1998) that has gained significant traction in the 21st century. In 2010, Cox et al. analyzed 91 studies on natural resource management and found that the benefits of Ostrom's principles are well-supported empirically and are well-accepted in the literature. In practice, these principles embrace the values of people involved in the management of a natural resource. For example, Ostrom (2009) found the importance of a resource to stakeholders to be a significant factor that impacts resource management.

Seymour et al. (2010) further asserted that individuals' values for specific places impact

natural resource management, and that managers must understand community values for those resources if they intend to invest public funds on highly-valued environmental assets. In other words, community members have specific values for nearby natural resources, and managers must take those values into account to most effectively manage those resources. Science and human values might be viewed as competing ideas in natural resource management. While both play important roles, some literature shows that values often are more influential than science in managing socio-ecological systems (Burton 2004; Wilmer et al. 2018).

The issue of wildfire risk mitigation is new to study as a socio-ecological system (Vigna et al. 2021), but it already has been shown to be reflective of human values. Johnson et al. (2009), for example, explored contrasting opinions of the Healthy Forest Restoration Act, with some individuals favoring the policy because of the reduced risk of wildfire while others opposed the policy citing environmental concerns. In another example, Sherry et al. (2019) studied the role of values in wildfire management and found that management concepts that are regarded as "scientific" are actually significantly shaped by stakeholders' values. Since values clearly play a large role in natural resource management, the question must be posed: whose values are included in management decisions?

1.2. Managing wildfire risk in the American West

Since the late 20th century, public policy on wildfire has embraced active

landscape-management due to consistently increasing costs of wildfire suppression, with the front-line effort typically being hazardous fuel reduction projects to reduce wildfire risk. Broadly speaking, these active land-management and community-adaptation projects can be referred to as wildfire risk mitigation projects. The Healthy Forest Restoration Act of 2003 in the United States emphasized the importance of fuels reductions, but the law did not provide adequate funding to reduce fuels at the pace or scale necessary to drive down suppression costs and infrastructure losses. With suppression costs and damages due to increasingly severe wildfires continuing to increase, more recent policy has allocated large amounts of resources to wildfire risk mitigation. The Wildfire Crisis Strategy (ca. 2022) from the United States Forest Service ("Forest Service"), for example, was designed to dramatically scale up hazardous fuels reductions with an estimated cost of $50 billion over ten years (Brown and Cooper 2022). This initiative is partially funded by more than $3 billion allocated to wildfire risk reduction in the Infrastructure Investment and Jobs Act (ca. 2021) and another $1.8 billion from the Inflation Reduction Act (ca. 2022). This money was allocated towards a goal of building "wildfire-adapted communities," or communities that are more resistant to and resilient from adverse impacts of wildfire. Beyond the recent large investments from the federal government, states are also investing large amounts of money into wildfire risk mitigation. In Oregon, the state legislature allocated $220 million into community adaptations to wildfire when they passed Senate Bill 762 in 2021.

Along with the recent influx in funding, the growing diversity of organizations involved

in different aspects of wildfire risk mitigation is increasing the need for collaborative, holistic wildfire management at a regional scale (e.g. Busenberg 2004; Miller et al. 2022). In collaborative natural resource management, landowners and managers work with informal networks of other landowners, nonprofits, and government agencies to collaboratively address collective, regional-scale environmental, social, cultural, and economic goals. Networks like this have been studied and referred to as "social influence networks" (Bodin and Crona 2009; Fischer and Jansey 2017; Spies et al. 2018; Friedkin 1991). In the context of wildfire management, they can be called "wildfire management networks." Research into the nature of these networks is ongoing (Fischer et al. 2016; Fischer et al. 2011), and one of the key questions falls at the intersection of wildfire management professionals and other stakeholders at large: how do professional wildfire management practitioners include non-manager stakeholders in collaborative processes? To what extent do those relationships affect managers' decisions about where, when, and how to implement wildfire risk mitigation projects?

1.3. Public engagement in natural resource management

A global-scale movement grew through the second half of the 20th century with the intention of increasing public participation in natural resource management (Hoogstra-Klein et al. 2012). For example, the UN Conference on the Human Environment in Stockholm (ca. 1972) and the World Charter for Nature (adopted by the UN General Assembly in 1982) both promoted public engagement as being vital for natural resource management to be sustainable. At the advent of the United States'

environmentalism movement in the 1960s, public discontent was swelling with regards to the standard practice of "expert-driven" natural resource management, which typically occurred with negligible input from communities near managed areas (Allen and Gould 1986). At the federal scale, two major pieces of environmental legislation codified the role of the public's voice in American natural resource management: the National Environmental Policy Act (NEPA), signed into law in 1970, and the National Forest Management Act of 1976. These laws mandated specific public engagement practices for projects on federal lands, including an environmental impact assessment with an associated public comment period and a final objection period where any stakeholder can raise concerns that they feel have not been appropriately addressed. One intention of these laws was to standardize the inclusion of public input in resource management, but as Lachapelle et al. (2003) discussed, public discontent about lack of influence remains. In the Northwest, the United States Forest Service implemented the Northwest Forest Plan beginning in the 1990s with a goal of promoting agency and citizen collaboration in forest management through the collaborative development of novel approaches to forest management that address ecological and social goals, but in an empirical study, Charnley (2006) found that goal to be unfulfilled due to a lack of power granted to citizen advisory committees.

Billgren and Hollmén (2008) illustrated how even a community-scale collaborative natural resource management plan excluded "common people" who were not part of a formal stakeholder group. In this example, a collaborative resource management plan was

created to identify and work toward local social and ecological goals. International NGOs (non-governmental organizations) had a seat at the collaborative table while workers on the farms did not. Billgren and Hollmén cautioned that this might become problematic over time if those people remain voiceless in the collaborative process due to continuously diverging priorities. In the United States, Frentz et al. (2000) found that technocratic public comment processes are barriers to the solicitation of public input, which has led to public feelings of disempowerment, acrimony, and distrust in land management agencies. Davenport et al. (2007) posited that this may be partly due to a lack of specificity on how exactly managers should best involve the public in planning. Today, in the literature, best practices for public engagement remain elusive in part because different communities hold different values, priorities, and cultural contexts. It is also unclear in the literature how natural resource managers' current practices typically involve the public in management decisions. This paper empirically addresses the latter: how do managers currently include public input in natural resource planning?

The practitioners who manage regional-scale wildfire risk ("wildfire managers"), too, understand the importance of connecting with members of communities where they operate (Madsen et al. 2018; Shindler et al. 2014). Many refer to the need for "social license" to be granted by the communities to implement management projects (e.g. Kelly et al. 2019). The concept of social license, which is a function of community trust in agencies, has no universal definition but typically refers to a community's support or lack thereof for industrial activities, especially for extractive industries like mining or timber

harvest (Kendal and Ford 2018). Functionally, social license can be viewed as a threshold of public trust: high levels of public trust in an organization allow it to operate, but if public trust drops below that threshold, the organization will no longer have social license and community opposition can halt their operations. The term faces major critiques in modern contexts because applications of the term have more often been about reducing overt opposition to industry or power structures than engagement for long-term collaborative resource management (Owen and Kemp 2013; Kendal and Ford 2018; Moffat et al. 2016). Despite that controversy, I use the term throughout this paper because regional wildfire managers frequently apply the term. Regardless of the best terminology, wildfire managers must intentionally leverage social support to continue risk reduction work in the face of public concerns over related environmental, sociocultural, and economic issues.

1.4. Collaborative governance as a theoretical framework

Collaborative governance theory is a framework that explicitly incorporates the role of relationships among stakeholders. I frame this study through the lens of collaborative governance based on a growing body of evidence supporting the importance of engaging a broad array of stakeholders in regional wildfire risk mitigation. Collaborative governance theory highlights the processes through which a variety of stakeholders engage with each-other, identify shared motivations, and build capacity to manage their communities and the resources therein. Conceptually, collaborative governance refers to the formal and informal mechanisms through which individuals work together to

collectively address issues that otherwise would be difficult or impossible to manage, while considering stakeholders' different priorities, resources, and levels of power (Emerson et al. 2012; Ansell and Gash 2007).

Emerson et al. (2012) presented an integrative framework of collaborative governance (Figure 1) and described the drivers, mechanisms, and outcomes of collaborative governance regimes. They defined a collaborative governance regime as a system of decision-making where "cross-boundary collaboration represents the prevailing pattern of behavior" (Emerson et al. 2012, p. 6). Regional wildfire risk mitigation is an effort that is ripe for study through the context of collaborative governance because a variety of stakeholders must collaborate toward a shared goal of reduced wildfire risk, although each actor possesses various amounts of resources, differing levels of agency, and non-identical priorities for the region's environmental, cultural, and economic outcomes.

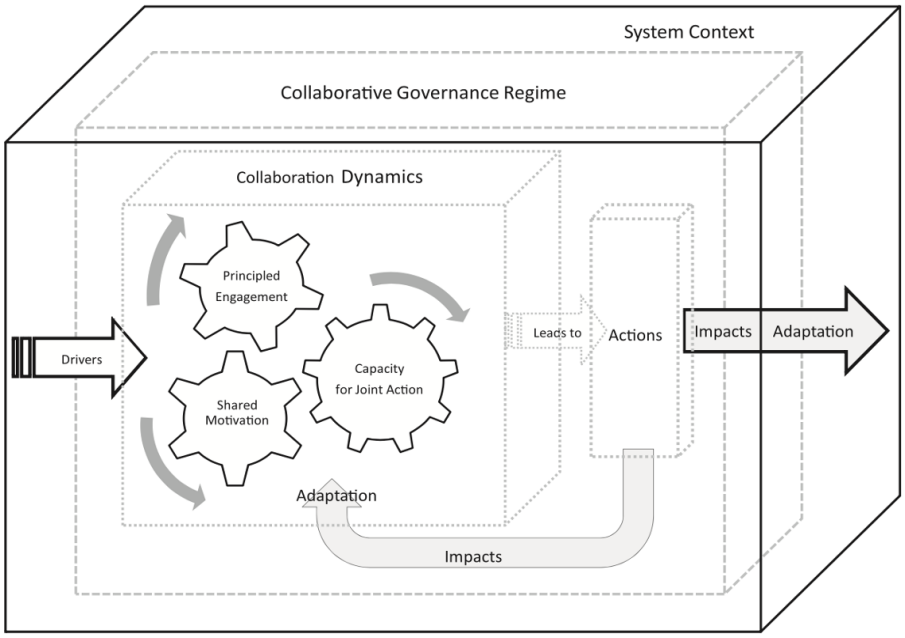

Figure 1: a conceptual model of a collaborative governance regime according to Emerson et al. (2012). The entire collaborative governance regime exists inside of the system's context. Drivers spark collaborative efforts, and those efforts are shaped by collaborative dynamics. Collaborative efforts may lead to actions, which have impacts on both the collaborative process and the system context. Based on those impacts, the collaborative governance regime will adapt to the new context.

1.4.1. Collaborative dynamics

Emerson et al. (2012)'s collaborative governance model includes three collaborative dynamics: *principled engagement*, *shared motivation*, and *capacity for joint action*—each theoretically representing an important aspect of collaboration. In practice, Emerson named four elements that comprise each of the three collaborative dynamics (Table 1). Each element represents a type of collaborative process, relationship, or tool. *Principled engagement* represents the variety of ways in which different groups of stakeholders engage in collaborative processes, which is embodied in four concrete elements: *discovery*, *definition*, *deliberation*, and *determination*, each representing a stage of a

collaborative effort. Using Emerson's definitions, *discovery* "refers to the revealing of individual and shared interests, concerns, and values, as well as to the identification and analysis of relevant and significant information and its implications" (Emerson et al. 2012, p. 12). *Definition* is a set of processes that "characterizes the continuous efforts to build shared meaning by articulating common purpose and objectives" (Emerson et al. 2012, p.12). *Deliberation* refers to processes that ideally would involve "hard conversations, constructive self-assertion, asking and answering challenging questions, and expressing honest disagreements" (Emerson et al. 2012, p.12) *Determinations* are made and are typically enumerable and explicit, and can include procedural decisions for collaboration or substantive agreements that are typically the output of the collaborative process.

Table 1: the three collaborative dynamics identified by Emerson et al. (2012) to be central to a collaborative governance regime. Listed below each are the four elements of collaboration that comprise each dynamic.

Collaborative dynamic:	**Principled Engagement**	**Shared Motivation**	**Capacity for Joint Action**
Elements that comprise the collaborative dynamic:	Discovery	Mutual Trust	Procedural/Institutional Arrangements
	Definition	Mutual Understanding	Leadership
	Deliberation	Internal Legitimacy	Knowledge
	Determination	Shared Commitment	Resources

Rooted in ideas about social capital, (Coleman 1988; Putnam 2000; Putnam et al. 1993) *shared motivation* represents the relationships between stakeholders that frame their

interactions, and is a proxy of these four elements: *mutual trust*, *mutual understanding*, *internal legitimacy*, and *shared commitment*, each of which represents an important aspect of a collaborative relationship. In Emerson's words, "*trust* has been found to be instrumental in reducing transaction costs, improving investments and stability in relations, and stimulating learning," because it "enables people to go beyond their own personal, institutional, and jurisdictional frames of reference and perspectives toward understanding other peoples' interests, needs, values, and constraints" (Emerson et al. 2012, p.13). *Mutual understanding* refers to stakeholders' understanding of and respect for each-other's perspectives and values, especially when they are different from one's own. According to Emerson, mutual understanding leads to *legitimacy*, or the understanding among collaborative partners that their counterparts are trustworthy and credible, which ultimately can facilitate *shared commitment*, social bonds that Emerson characterized as the element that can "enable participants to cross the organizational, sectoral, and/or jurisdictional boundaries that previously separated them and commit to a shared path" (Emerson et al. 2012, p.14).

The final collaborative dynamic, *capacity for joint action*, represents the ability to accomplish more collaboratively than would be possible individually, and in practice encompasses four "necessary" elements, according to Emerson: *procedural and institutional arrangements*, *leadership*, *knowledge*, and *resources*, each of which describes a type of asset to be leveraged in a collaborative engagement. *Procedural and institutional arrangements* are formalized agreements that maintain the structure of

collaboration by facilitating repeated interactions over time. The second element, *leadership* typically refers to individuals who provide the necessary spark for collaborative actions to begin. Emerson acknowledged that different leadership roles like sponsors, facilitators, advocates, etc. are necessary at different stages in a collaborative process. *Knowledge* is an element that guides collaborative actions and is gained, contested, assembled, and shared throughout a collaborative process. The final element in Emerson's framework is *resources*, which are typically unevenly distributed across stakeholders at the onset, and the reallocation and sharing of resources are vital to collaborative efforts. In Emerson's words, "the perceived and real fairness, legitimacy, and efficacy of collaborative governance regimes can depend on how well these resource differences are managed" (Emerson et al. 2012, p.16).

1.4.2. Utility of collaborative governance as a framework

Applications of collaborative governance theory in natural resource management have been shown to facilitate positive outcomes (e.g. Mattor et al. 2020; Fisher et al. 2020; Montero et al. 2006), although so far the theory has seldom been applied to wildfire risk mitigation. One exception is Brummel (2010), who empirically analyzed wildfire management in Southeastern Australia and the Western United States and concluded that managers have enhanced wildfire risk mitigation efforts by leveraging collaborative governance. More recently, in a theoretical paper, Miller et al. (2022) advocated for increased collaboration in anticipatory wildfire management and discussed the potential usefulness of collaborative governance in wildfire risk mitigation. Finally, Miller et al.

(2017) mentioned potential for the application of collaborative governance theory to wildfire risk mitigation, but fell short of applying the theory in their own empirical study, citing a need for more information about how federal wildfire managers and local actors interact in the context of wildfire risk mitigation.

In this paper, I demonstrate the usefulness of applying collaborative governance theory as a framework to regional wildfire risk mitigation by analyzing interactions between local communities and federal, state, local, and regional wildfire managers. Public engagement in natural resource management is not only mandated by policy but also viewed as beneficial to the long-term outcomes of management projects (Steel and Weber 2001; Rall et al. 2019; Uittenbroek et al. 2019). Even so, the mechanisms through which public input might be incorporated into manager decision-making are not documented in the literature. I address this obscurity by presenting the perspectives of managers working to mitigate wildfire risk in Central Oregon and highlighting the mechanisms through which the Central Oregon public influences the design and implementation of regional wildfire risk mitigation projects. As called for by Miller et al. (2017), clarity in how managers and community members interact to design wildfire risk mitigation projects will facilitate the development of theory about interactions between communities and the environment. Furthermore, this clarity might help contextualize theory around collaborative natural resource management in ways that are applied and meaningful to practitioners and researchers alike.

2. METHODS

2.1. Study area

This study focuses on Central Oregon, including all of Deschutes and Jefferson counties and parts of Crook county. In several studies, the fire-prone region of Central Oregon in the United States (Figure 2) has been identified as being at high risk of exposure to wildfire (Fischer et al. 2016; Ager et al. 2022; USDA Forest Service 2022). There have been a few recent attempts in the United States to identify where communities are at high risk to wildfire exposure. For example, Ager et al. (2021a) used a modeling approach to identify "firesheds" (for more on "firesheds" see Ager et al. 2021b) where wildfire poses significant risks to human developments, and the 2022 US Forest Service's Wildfire Crisis Strategy identified two dozen high-risk firesheds in close proximity to land managed by the Forest Service (USDA Forest Service 2022; Evers et al. 2019). Prior research has identified the members of the Central Oregon wildfire management network (Evers et al. 2021; Fischer and Jasney 2017; Spies et al. 2014), priming this region for study as a socio-ecological system.

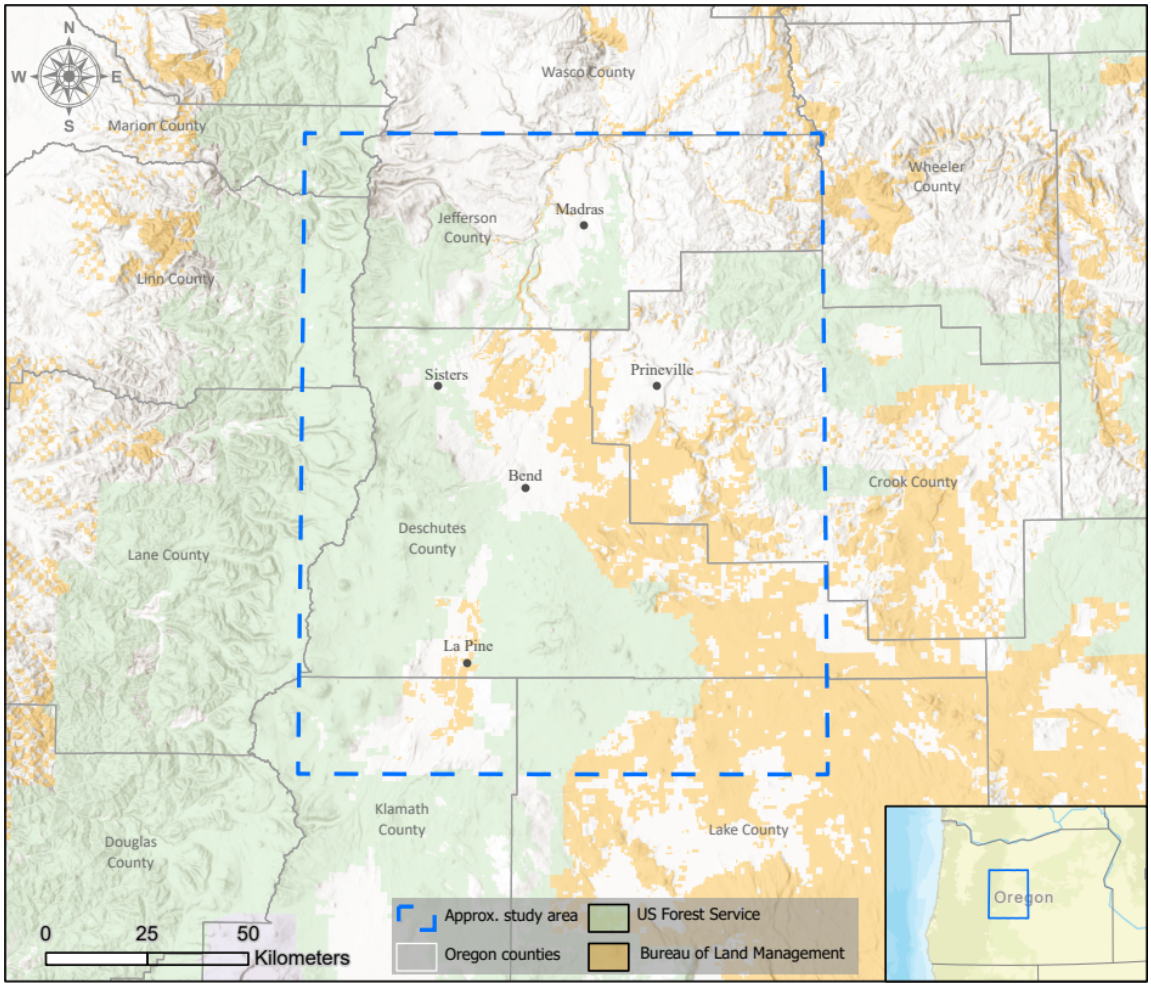

Figure 2: a reference map of the Central Oregon study area. Approximate boundaries are outlined in blue. Federal land is highlighted in light green (Forest Service) and light orange (Bureau of Land Management).

The majority of Central Oregon is composed of federal lands, like the Deschutes National Forest on the western side, the Ochoco National Forest on the northern and eastern sides, and Bureau of Land Management lands across the study area. The northern part of the region includes the Confederated Tribes of the Warm Springs Indian Reservation. In much of the region, sparsely populated private lands are interspersed throughout areas of federally-managed land. The city of Bend is the center of commerce in the region, and the greater Bend area is home to over 100,000 residents– a number that is rapidly

climbing, as the city added 30% to its population between the 2010 and 2020 censuses. Smaller cities in Central Oregon include Redmond, Madras, La Pine, Sisters, and Prineville. Because of their population densities and history of smoke incidents, Bend and Redmond are protected under state policy as smoke sensitive receptor areas (SSRA), meaning that they must not be exposed to any smoke from prescribed fire. A number of organizations and agencies are involved in managing wildfire risk in Central Oregon, including federal agencies like the US Forest Service and the US Bureau of Land Management, state agencies like the Oregon Department of Forestry, NGOs like The Nature Conservancy, tribal government, local fire departments, the Oregon State University Extension, and others. Many of these organizations are represented in at least one of the two forest collaboratives in the region, the Deschutes Collaborative Forest Project and the Ochoco Forest Restoration Collaborative, which typically serve as a formal setting for deliberation about forest management, including wildfire risk mitigation.

2.2. Participant selection and demographics

In total, I conducted semi-structured interviews of 13 professionals working on wildfire related issues in Central Oregon to characterize their relationship with the public. These 13 people were sampled from the 210 individuals who were previously identified as being part of Central Oregon's wildfire management network (Evers et al. 2021). I used a purposive sampling method to select individuals from that list who represented a range of organizations, job-types, and location. Of the 13 individuals that agreed to an interview,

seven worked for federal natural resource management agencies, two worked for NGOs, two worked for local fire districts, one worked in tribal government, and one worked in the private sector as a consultant. I intentionally selected more federal natural resource managers than others because much of the region consists of federal lands managed by federal actors who implement the majority of physical wildfire risk mitigation projects across the landscape. Gender of participants skewed slightly male, with eight men and five women participating. This slight skew is reflective of the wildfire management network itself, which was found to be 65% male and 35% female (Evers et al. 2021).

2.3. Procedure and data collection

I conducted all interviews myself, along with one colleague who sat in on 11 interviews to assist with reliability in theme development. I conducted nine interviews in-person in June 2022. Of those, I interviewed seven individuals at neutral sites like coffee shops and pubs to allow interviewees to feel comfortable speaking openly, including being critical of their own organizations. I conducted the other two in-person interviews in the participants' offices at their request. Additionally, I interviewed four participants using Zoom video teleconferencing to allow for flexible scheduling that was not dependent on the timeline of my fieldwork. To validate the reliability of the themes drawn from these interviews, I engaged in participant observation during subsequent stakeholder focus groups and seminars, though no new data was collected or analyzed during these events.

Interviews were semi-structured to allow interviewees to speak to their particular experience and allow for follow-up questions on ideas of particular relevance to this project. I began each interview by asking the participant to speak about general personal information, including how long they have lived in the region, how long they have worked on wildfire-related issues, their job title and typical responsibilities, etc. From there, I posed questions to probe each participant's general attitudes towards collaboration on wildfire risk mitigation and who their typical collaborative partners are. Then, I asked about their general relationship with the public and how public input does or does not impact their management actions. Because not everybody has the same understanding of who is or is not part of the general public in Central Oregon, I left it up to each interviewee to define the group themselves, premising "the public" as a boundary object with no strict definition. Typically, I provided one suggestion: to exclude professionals working on projects specifically related to wildfire risk reduction from their definition of the general public. I closed each interview by asking for their perspective on the state of wildfire risk in the region and what the future of collaborative management should look like. Interview questions were developed to probe ideas pertaining to each collaborative dynamic in Emerson et al. (2012)'s collaborative governance framework.

I ceased conducting interviews after I reached theoretical and geographic saturation. For example, I consistently heard from interviewees about NEPA as a formal means of including public input, and after 13 interviews, I had not heard any new information about mechanisms for formally including public input. After these 13 interviews, I had

heard from wildfire managers in most of the relevant geographical subregions. During interviews, I took notes about the general themes and interesting anecdotes described by each participant. I also recorded and transcribed each interview using Otter AI, an automated transcription service.

2.4. Coding and data analysis

I coded the transcript for each interview using MAXQDA, a qualitative data analysis software. For this analysis, I used a flexible coding method similar to the one outlined by Deterding and Waters (2018) because I conducted every interview myself, reflected on my notes, and developed a broad understanding of the themes expressed prior to coding. I began with three major codes that I developed a priori, and gradually incorporated more detailed sub-codes throughout the iterative coding process, while also being alert for novel themes. Generally, I looked for instances where managers designed and/or adjusted their wildfire risk mitigation project based in part on public input, instances where managers specifically ignored or did not seek public input when designing and implementing projects, and sections of each interview where managers reflected on the impact of public input on their organization's reputation and the associated long-term effects of that reputation. I then created and reflected on additional notes highlighting the findings of each theme and variability therein. I conducted the coding process by myself, although I consulted the colleague who sat in on the interviews throughout and after the coding process to enhance the reliability of my interpretations.

3. RESULTS

3.1. Formal proceedings: direct influence of the public on wildfire risk mitigation projects

I found that generally, input from non-manager community members has limited direct influence over when, where, and how wildfire risk mitigation projects are planned and implemented. With few exceptions, input from the Central Oregon public is typically limited to feedback during formal proceedings, like the public comment and final objection periods mandated by NEPA. Take, for example, the reflections on public comment by one federal employee who facilitates the NEPA process for natural resource management projects (participant #6):

> Public comment, in my experience on projects, it's something that we weigh out and if there are modifications we can make, we do, and that's where, with the environmental impact assessment, we put out a proposed action, we get public comment back, and then generally we create alternatives. That's part of that mandate.

Agencies are compelled by NEPA to take public comment into account when planning natural resource management projects. This federal employee clearly stated that formally submitted public comment is considered while they are planning wildfire risk mitigation projects. Another federal employee, a natural resource manager (participant #10), told a similar story when asked for their take on how public input gets incorporated into hazardous fuels reduction projects by saying, "It's all through that NEPA process… getting the comments back, and okay, they define that decision through the NEPA process. Yeah, it's the standard way, if you will."

On a couple of occasions, I was told about one hazardous fuels reduction project that was especially reflective of public input. This project included an environmental assessment, as is standard in the NEPA process. According to one federal-agency fire manager (participant #7), the environmental assessment included "some of the neighborhoods sending us maps with areas drawn that they want to see work done… areas that, yes, they needed that work." Speaking about the same project, another federal natural resource manager (participant #9) claimed that "we were able to go in based on the specific areas where they wanted us to work, and we were able to do some focused treatments." The type of specific feedback described by participant #7, in this case highlighting specific spots that needed attention within an area that was already slated for a project, is the type of information that managers may consider especially when submitted formally through proper channels. In this case, the agency was able to apply focused treatments to the relevant areas.

These managers were clear that the direct influence of the public is channeled through the public comment periods during the NEPA process, labeling it "the standard way." This sentiment may be frustrating to hear for some members of the public, as some tend to feel "cynical" about the impact of the public comment process, according to the federal employee who facilitates the NEPA process (participant #6). Frustrations about the nature of the NEPA process might be justified, as much of the comment submitted through the process can be tuned out. I identified two reasons that explain why formally submitted

public comments are often excluded from a project. I discuss both of these reasons in the following subsection.

3.2. Why managers refrain from designing projects based on specific public input

3.2.1. Misinformed public:

Managers often spoke about public feedback that cannot be incorporated into projects because many comments demonstrate little understanding of the complex policy that guides natural resource management projects. Take, for example, the continued reflection on public comment by the federal employee who facilitates the NEPA process (participant #6):

> We often get comments for things that we couldn't do even if we wanted to, right? Or comments to say, "you should not be doing this thing," and we're like, "well, the Endangered Species Act says that we have to do it." So, there's some aspects of law and policy that already tells us, so it's already been decided.

This is far from the only example of managers rejecting public input because of a misinformed public. Wildfire risk reduction projects implemented by federal agencies are designed primarily by agency professionals with strong backgrounds in ecology and natural resource policy. As one nonprofit policy consultant (participant #1) put it, "I think a lot of the fire agencies are pretty darn sure they know what they're doing. And they don't need any input from anybody else." This consultant was clear that, especially in the federal agencies, wildfire managers may not be eager to look to public comment to guide their projects. Take another example from a federal-agency fire manager, regarding

informal feedback from the public on hazardous fuels reduction projects (participant #10):

> On the district here, there's been at least two places where people are like, "Oh my gosh, you killed everything in there." And, in some areas, maybe it was a clump that did completely die, which still meets the prescription of what we're looking for… And sometimes the gauge of the public doesn't understand what that looks like.

Comments like this one referenced by the respondent are especially unlikely to be considered when designing wildfire risk mitigation projects simply because, from most wildfire managers' perspectives, members of the public typically do not have a strong understanding of the project's goals, its guiding policy, and local ecological context. This example was one of many where public input is not expressed formally through the NEPA process, but informally through phone calls, email, social media, or in-person interactions around the community.

3.2.2. "Short-term memories":

The other reason I identified that explains why managers tend to not incorporate specific public feedback into projects are the "short-term memories" of the public when it comes to unpopular projects. A federal-agency fire manager (participant #10) summarized this concept by discussing how public opinion tends to fluctuate over time:

> Well, [public opinion] just ebbs and flows. You know, people have short-term memories, really… Generally, people just want to vent. I think most of the time they just want to be heard.

This concept of public opinion "ebbing and flowing" appeared frequently throughout the interviews and seems to be well acknowledged by wildfire managers. Some larger

wildfire risk mitigation projects have been implemented over longer periods of time, and managers have even witnessed public opinion change over the course of a long-term project. Another fire manager for a federal agency illustrated their experience witnessing public discontent fade during the course of a nearly decade-long project (participant #9):

> The West Bend project has been going on for eight or nine years now... I remember people kind of freaking out when we started West Bend, when we did the first logging… Yeah, people were pretty upset, or some people were. And then they got used to it and I don't know if they even remember that anymore. And yeah, now most of the areas where we've done prescribed burning in there, it just looks like it's always been that way.

This manager claimed that public opinion can shift dramatically even over the course of a single project as community members grow accustomed to the changed landscape with the passage of time. In some cases, especially with the occurrence of a major event like a nearby wildfire, public opinion about wildfire risk mitigation projects can change seemingly instantly. Consider an illustration from a federal fire manager (participant #10) about an unpopular hazardous fuels reduction project near a neighborhood that was quickly followed by a major wildfire:

> There's a place south of town here where people were just completely beside themselves that we were in there burning. Didn't want to see it. Not in my backyard. And you know, that same summer after we burned it, the Milli fire came through, and they were like… "We were so worried before. We're so glad that now that this work's done. Let's keep encouraging this work."

After a close call with wildfire, residents were suddenly able to understand the benefit of the prescribed burn near their neighborhood. This is a clear illustration not only of how quickly public opinion about wildfire risk mitigation projects can change, but also of why wildfire managers may not be overly concerned about designing their projects around

public input. While specific feedback submitted through formal processes might be included when possible, managers design projects to meet specific ecological, policy, and community safety goals that they determine based on agency or organizational directives. From managers' perspectives, undue influence from the public might reduce their ability to meet those objectives, and the consequences could be dire. Most managers feel that by prioritizing public safety and completing wildfire risk mitigation projects according to the best available science, they build strong relationships with the public in the long-term as the projects prove to be beneficial, which then allows them even more freedom to complete less popular projects. Another example from a manager at a rural fire department (participant #11) illustrates how, with a good reputation, public discontent is typically short-lived after an unpopular project:

> You know, [contentious projects] can tarnish your reputation, but I think it's short lived. You know, with the fires being around for so many years, and if you have a good community, and if you've done everything you can for that community… we've created this trust with our public, for decades.

One of the most common threads that emerged as I spoke with Central Oregon wildfire management practitioners was this idea that an organization's reputation and the resulting public trust in that organization is beneficial to managers. Herein lies perhaps the most consequential way that the Central Oregon public can impact wildfire risk mitigation efforts: managers consider public input much more frequently through the informal process of cultivating public trust over long periods of time than they do over the course of individual projects, formally or informally.

3.3. Indirect influence of public input on wildfire risk mitigation

3.3.1. Social license– utility and constraints:

Many of the agencies and organizations working on natural resource management in Central Oregon have been operating there for generations. The most impactful way that managers allow public input to shape wildfire risk reduction efforts appears to be through careful maintenance of the organizations' reputation in the community. To maintain social license, wildfire management practitioners in Central Oregon work hard to cultivate public trust in their organization and, more broadly, in regional wildfire management operations. This trust is built and managed over the course of decades, not individual projects. Consider a metaphor offered by a federal natural resource manager (participant #4) about maintaining the social license built by two of their predecessors (pseudonyms used for confidentiality):

> Well, I think a lot of it was [Fred]. You know, he was here during the B&B fire. And then [Michelle] came after him. [Fred] was here a long time. I think he was here 14 years. And then [Michelle] was here five. So, you know, I think they did a lot to kind of build that foundation. So now, there's a cabin built and I'm just trying to keep all the nails from rusting out on it, right?

This metaphor of maintaining a cabin is a clear summary of how social license is maintained after building trust in prior decades. Current natural resource managers must work throughout their careers to maintain public trust in their organizations, which they then pass to their successors. Without social license, wildfire risk reduction projects tend to face more scrutiny and are more likely to be litigated, as discussed here by a private-sector wildfire safety consultant (participant #3), who reflected on an incident in which a federal agency violated public trust:

> I think that there will be a lot more scrutiny of the projects that move forward from [the agency] now. There's a little bit of public trust that's been lost, right or wrong, and you know, it'll take them a while to build that back up. They have some good people working on it, and I think they'll get there, but anytime you have a setback, it's like your new priority is getting that trust back, really, because, especially at the federal level, that's the only thing that allows you to move forward, because if you don't, every project that they've gotten through in the last 10 years or more would have been challenged in court. No doubt about it.

This account clearly expressed the importance of maintaining public trust and illustrates just how high of a priority building and keeping social license is to managers. Some communities require more or less trust to give social license, though. For example, one fire manager for a federal agency (participant #9) characterized the level of public trust necessary to achieve social license in working-class communities as sometimes being lower than in other communities, since those individuals might be more concerned about making ends meet than engaging in wildfire management. This manager said: "As for us doing work, I mean, if there's a neighborhood that doesn't comment on anything, yeah, we can plan the project… No one's gonna cheer for it or complain about it, so sure." Regardless of the precise level of trust necessary for social license to be granted for a project, when public trust in fire management organizations is high, managers are sometimes able to move other barriers to enable more work. A few managers described to me an instance when, based on a community letter-writing campaign, state regulations governing acceptable levels of smoke from prescribed fire were changed to allow for more prescribed burns. As the above-mentioned wildfire consultant (participant #3) put it:

> There was a glimmer of hope towards the very tail end of my (first) career that, because we had more social support, that we would be able to move

> the bar on the regulatory side, because there was a point in time in which the City Council for Bend and the County Commissioners for Deschutes County wrote letters to Oregon DEQ (Department of Environmental Quality) and said, "You gotta loosen up these rules so that the federal agencies can do more prescribed fire so that we can better protect our communities. We're hamstrung, we can't do the work." So, I think there was a lot of support. And those entities wouldn't do that if they didn't believe that they had the votes to do it.

In this case, management organizations were able to leverage public support to lower a regulatory barrier, allowing them to increase the scale of prescribed burns. Beyond using politics to change regulations, public support can also be leveraged to build capacity through attracting funding. One planner for an NGO, who works with communities interested in the "FireWise" accreditation process (participant #5) , described to me how public support can increase the likelihood of their organization receiving grants from outside funders:

> Say you're wanting to [receive funding for] a Firewise coordinator for Jefferson County. In that grant application, you might say, "We're gonna get 10 new communities on board in the next two years…" You build that strong relationship with those FireWise communities so that they can come out and say, "Hey, we really support this, we've learned a lot, we have a great relationship with our local fire folks now, and we feel empowered and knowledgeable about this." Bringing folks who have experienced it from the community firsthand in to share that story. And [when renewing funding, the funder might consider] did the community go for recertification? Are they continuing that process?

In cases like this, managers might be able to attract funding to scale up their work by leveraging public support. The two prior examples illustrate how public opinion and organizations' reputations can enable more wildfire risk mitigation work. On the other hand, the need to maintain that reputation and public support can constrain some projects that managers would like to implement. Nearly every interviewee mentioned that smoke

from prescribed fire is a major concern among the public. Especially while burning near communities, managers are very careful about when, where, and how much smoke they produce. In some cases, they go so far as to delay implementation of a prescribed burn because of concurrent events in a nearby community, even though the amount of smoke they can produce in prescribed burns near communities is already specified by state regulations. One natural resource manager (participant #4) illustrated this using the example of school sports:

> Say there's a unit, and we need to burn it under a south wind, and we never get south winds here, but we know that's going to push [smoke] right into the school… When the AQI is a certain level, OSAA (the Oregon School Activities Association) will not let athletes compete. And so when you have teams visiting town that travel a long way to come here, and you know, parents take time off work, and they get hotel rooms and everything, if they can't compete, I mean, that's a huge deal, right? Because of our smoke… It's like a go/no-go decision that morning... You know, I've said before, "Nah, we're gonna hold off."

This manager described how sometimes agencies are willing to call off prescribed burns that require uncommon weather conditions for the sake of maintaining public support, even though the smoke they might produce would not exceed the levels that they are allowed to produce under state regulations. In this way, the maintenance of social license can be a major constraint on the wildfire risk reduction work that managers can implement.

3.3.2. Losing and building social license:

Despite long-term investments in building public trust, social license can be tricky to manage because it can take decades to build enough public trust to attain social license,

yet that license can be revoked after even a single violation of public trust (e.g. Gunningham et al. 2005). Take for example a recent incident (Spring 2022) where a hazardous fuels reduction project was implemented near a popular mountain-biking trail. In this incident, a number of large trees (that notably did not meet the operational definition of "old growth") were cut during mechanical thinning. There is debate about whether the implementation met the prescription and original vision for this project, but regardless, some members of the public were deeply upset and clearly expressed their concern. A natural resource policy specialist (participant #1) offered their assessment of the incident:

> The Forest Service was like, "Yeah, it might be a mistake. But, you know, come on, we marked 27,000 acres, like, you're talking about 30 trees, this is not a big deal." And then, of course, the public's response was, "Well, you did a not very good job on the place that is right next to the mountain biking trail, how do we know that the other 27,000 acres were marked correctly?"

Natural resource managers conduct projects in a variety of areas, some more visible than others. In this case, the incident occurred in an area that is extremely visible to the public, which caused people to question the agency's trustworthiness in other, less visible areas. The impact of this event on the agency's trustworthiness might be limited to a short period of time, or it could affect the agency's reputation for much longer. That depends in large part on the agency rebuilding its credibility. According to most managers, a primary tool for building trust is through community education. The US Forest Service, for example, maintains a staff of Public Affairs Officers for the purpose of responding to public concerns with information about ecology, the forest, and their management

practices. A planner for an NGO that works on community-driven wildfire risk mitigation projects (participant #5) described one education initiative and its outcome:

> The Deschutes forest collaborative did a huge campaign a couple of years ago, and they've put a lot of resources and time into public education about prescribed fire and smoke and why it's important. So I think the [public] is like "Okay, we accept it. We still hate it. But you know, we understand why it has to happen."

According to this planner, public acceptance of prescribed fire and smoke is a direct result of public education initiatives. Constant education for the community is especially necessary now, given the rapid influx of new residents to the region, to maintain public trust in fire management operations.

Clearly, organizations involved in wildfire risk mitigation are very concerned with maintaining their reputations. Because general trust from the public lowers the risk of their projects being delayed or stopped by litigation, regional wildfire managers tend to make maintenance of public trust a top priority. This effort to build and preserve public trust and social license appears to be the most impactful mechanism through which the Central Oregon public influences wildfire risk mitigation projects. The impact is less direct and less specific than feedback expressed through formal proceedings like the NEPA process, but in gross terms, the impact of the former appears to be larger than that of the latter.

4. DISCUSSION

Generally speaking, wildfire risk mitigation in Central Oregon is a highly collaborative process that includes a range of agencies, organizations, and interest groups. Still, as Billgren and Holmén (2008) discussed, this model of collaboration does not meaningfully include the vast majority of the public, most of whom are not affiliated with or directly represented by special interest groups, in planning. Through specific technocratic processes, the unaffiliated public can still offer specific feedback on wildfire risk mitigation projects, but direct impact of those processes are generally limited to instances when community members can offer important information about the ecological or social context of an area already slated for restoration. When feasible and appropriate, managers will incorporate, but not necessarily solicit, public input into their project plans, which typically involve slight modifications like leaving trees at a higher density in a riparian zone or waiting to implement a prescribed burn until a particular wind condition. The major way that wildfire managers allow the Central Oregon public to shape their work, though, is a much less direct mechanism that considers the importance of building public trust in their organization to responsibly manage wildfire risk in the region. To avoid troublesome litigation (e.g. Jijelava and Vanclay 2018), managers carefully design projects based on their past interactions to be tolerable by the public, which usually entails designing them to maximize public safety and meet ecological goals while limiting impacts to scenic quality or recreation and implementing projects in ways that provide minimal disruption to community events and day-to-day life.

4.1. Central Oregon wildfire risk mitigation: collaborative dynamics in practice

4.1.1. Principled engagement

The application of collaborative governance theory can help contextualize the substantial impact of social factors that influence wildfire risk mitigation. In our interviews, Central Oregon wildfire managers frequently referenced practices involving the public that can be related to the *definition* element of principled engagement, based on the model of collaborative governance established by Emerson et al. (2012). Interviewees discussed the importance of community education initiatives that are designed to get stakeholders on the same page about the region's fire history, ecology, desired management outcomes, and necessary management practices. This aspect of Central Oregon wildfire risk mitigation efforts clearly reflects Emerson's understanding of *definition* as being necessary to articulate common purpose and objectives, agree on concepts and terminology, and clarify roles and expectations through engagement with stakeholders. Like most elements of Emerson's collaborative governance model, Central Oregon wildfire managers also engage in *definition* with other stakeholders through the forest collaborative organizations, though these practices largely do not involve the public.

4.1.2. Shared motivation

Central Oregon wildfire managers' large investments into the maintenance of their reputation can be tied to all four of the elements in Emerson et al. (2012)'s *shared motivation* collaborative dynamic: *mutual trust*, *mutual understanding*, *internal legitimacy*, and *shared commitment*. Managers spoke directly about the importance of

trust in their organization and their commitment to maintaining public trust. Managers' commitment to public trust will likely prove to be instrumental as managers attempt to scale up wildfire risk mitigation efforts in the coming years, as trust is a key element in reducing transaction costs, improving mutually beneficial relationships, and exchange of knowledge (Koppenjan and Klijn 2004). *Mutual understanding* is demonstrated when, despite their management priorities, managers adjust implementation of projects to only minimally disturb public activities that are of high value to the community, like refusing to implement a prescribed burn because smoke might negatively impact concurrent athletic events or festivals, as illustrated in participant #4's quote about refraining from implementing prescribed burns concurrently with community events. On the other hand, public acceptance of some amount of smoke from prescribed fire illustrates the public's understanding of management priorities.

This commitment on both sides also contributes to building *legitimacy* among stakeholders. By accepting some level of disturbance from projects, the Central Oregon public demonstrates that they are willing partners in the shared endeavor of wildfire risk mitigation. In turn, management organizations demonstrate legitimacy by maintaining their reputation as being stable, trustworthy, and credible. This is necessary to maintain the collaborative governance regime because, as Thomson and Perry (2006) discussed, legitimacy enables ongoing collaborative efforts by reinforcing confidence in the efficacy of the collaborative dynamics. In other words, by demonstrating legitimacy, stakeholders in Central Oregon are advancing a commitment to working toward long-term regional

goals. Emerson referred to this as *shared commitment*, the fourth element of the shared motivation dynamic.

Shared commitment is theorized as being a result of legitimacy, and according to Emerson, it is this commitment that facilitates participants crossing organizational boundaries to accomplish collaborative work. Without the legitimacy that has been built by management organizations investing in their reputation, stakeholders in Central Oregon may not be willing to commit to a shared path. A concrete example of this is the Central Oregon Fire Management Service (COFMS), which was created when the US Forest Service and the US Bureau of Land Management, two distinct federal agencies, decided to merge their fire management operations in Central Oregon. Both agencies have been managing lands in the region since the early 20th Century and have demonstrated themselves to be legitimate partners, despite the agencies' nonidentical management priorities. If legitimacy were in question, a partnership like COFMS would not be possible, as organizations typically avoid investing resources into collaboration with illegitimate partners (Abrams 2019; Tyler 2006). While this partnership does not directly reflect the relationship between the agencies and the public, the public is able to observe and have confidence in the legitimacy demonstrated through this partnership and understand that the variety of organizations involved in Central Oregon wildfire risk mitigation share a commitment to the region.

4.1.3. Capacity for joint action

In Emerson et al. (2012)'s framework, the foundation of COFMS is also evidence of one element of the *capacity for joint action* dynamic: *procedural and institutional arrangements*. Several formal arrangements facilitate joint action by organizations and special interest groups, like "shared stewardship agreements" between federal agencies and timber contractors, the Deschutes Collaborative Forest Project, and other joint efforts, but an example that more directly includes the Central Oregon public is the other mechanism through which the public influences wildfire management work: formal procedures like those mandated by NEPA. Bearing in mind the planned investments into Central Oregon wildfire risk mitigation, continuation of and upgrades to these formal procedures may lead to more effective regional scale work, as Emerson underscored the importance of formal rules and protocols that govern collaboration for accomplishing long-term collaborative work in complex systems.

4.2. Elements of wildfire management with little or no inclusion of the public

Wildfire managers in Central Oregon are wise to invest so heavily in maintaining their reputation in the community because in doing so, they address all four of the elements that comprise the shared motivation dynamic of Emerson et al. (2012)'s framework. As managers themselves claimed, this investment has proven to be instrumental in the region-wide wildfire risk mitigation work that has already been completed. With that said, the application of collaborative governance theory has illuminated a few potential areas where investments in collaboration with the public have not yet been fully

demonstrated. Billgren and Holmén (2008) documented how unaffiliated community members might have assets to assist natural resource management that are underutilized because those individuals are not engaged at the collaborative table, and the same appears to be true in Central Oregon. Organizations represented at the forest collaboratives are engaged in nearly the entire collaborative process, while the majority of community members are not part of a formal organization and are generally not engaged, and are therefore less likely to leverage their potential resources.

Specifically, Emerson's idea of the principled engagement collaborative dynamic includes three elements that I did not find the Central Oregon public to play an impactful role in: *discovery*, *deliberation*, and *determinations*. For example, consider the statement by participant #1 that "a lot of the fire agencies are pretty darn sure they know what they're doing. And they don't need any input from anybody else." This sentiment captures the idea that wildfire managers can be reluctant to relinquish influence over decisions pertaining to regional wildfire management (*deliberation* and *determinations*). Similarly, the statement from participant #9 that "if there's a neighborhood that doesn't comment on anything, yeah, we can plan the project" indicates little motivation for actively soliciting input from members of the public in the collaborative process (*discovery*). Certainly many collaborative partners in Central Oregon are engaged in wildfire management, especially the organizations represented at the forest collaboratives, but by leaving out the broader public, I posit that managers are limiting

the capacity of their collaborative efforts by not fully leveraging the potential assets that Emerson et al. (2012) described as capacity for joint action.

In the collaborative governance framework, Emerson theorized that capacity for joint action is a function of principled engagement and shared motivation. Accordingly, it could be theorized that by not adequately including the public in the processes of principled engagement, managers are leaving some adaptive capacity untapped. Specifically, there are three elements of capacity for joint action that I did not observe the public to be notably engaged in: *leadership*, *knowledge*, and *resources*. Certainly, there may be some instances where members of the public provide these assets, but they were seldom mentioned by participants who frequently touted their formal collaborative partners' leadership, knowledge, and resources, indicating that members of the public likely provide little of this capacity relative to agencies and formal organizations. Creating a collaborative environment in which the public can apply their assets could increase overall capacity for wildfire risk mitigation across the region, and might be achieved through investments related to developing impactful engagement.

4.3. "Social license" or "social capital": recommendation for managers' vernaculars

The results presented here clearly illustrate why the maintenance of public trust and subsequent social license is vital to regional wildfire management in Central Oregon. Still, the very concept of social license is premised on the idea that managers should be in charge of designing wildfire risk mitigation projects, and those projects only need to be

minimally acceptable to the public. Many scholars (e.g. Leena et al. 2019) have linked the concept of social license to social capital, but highlight that the development of social capital deepens managers' understandings of community perspectives through active dialogue, compared to the development of social license which often occurs through one-way communication, often referred to by Central Oregon wildfire managers as "education." Replacement of the term "social license" with "social capital" in managers vernaculars might be seen as desirable by some to better represent the investment needed from all parties to build mutual capacity (e.g. Cernea 1993; Leena et al. 2019; Coleman 1988; Putnam et al. 1993; Putnam 2000). Further, replacement of the term "social license" could create potential for managers to reassess their role in community wildfire adaptations and the role of relationships between public agencies and the public itself.

While wildfire managers tout the use of the best available science in decision-making, consider Sherry et al. (2019)'s argument that management concepts regarded as "scientific" in nature are actually shaped by values. Serious questions emerge considering the nature of community adaptations to wildfire risk: who should be included in the process of designing projects to create wildfire-adapted communities, and how much influence should they have? Wildfire managers certainly have the strongest understandings of fire ecology, policy frameworks, and potential actions to mitigate wildfire risk, but based on principles of democracy, self-governance, and federalism (Barthold and Bloom 2020; Hirokawa and Rosenbloom 2015), community members themselves should have some amount of influence in redesigning their communities to be

wildfire-adapted. The proper amount and the best potential role of that influence is subject to debate, and may relate to different conceptions among stakeholders about exactly what the risks of wildfire are (see Paper II). Nonetheless, wildfire managers and communities alike should reflect on difficult questions about the type and amount of influence that should be granted to each stakeholder because, while science is certainly an important tool, natural resource management ultimately is a social process and decisions are rooted in values. One way to begin this debate could be to consider application of the concept "social capital" in lieu of "social license" to create a collaborative environment where community members themselves are actively engaged in decision-making.

4.4. Expanding the Central Oregon collaborative governance regime

Based on the findings presented here, one could theorize that since wildfire management organizations in Central Oregon currently demonstrate strong command over the shared motivation dynamic of collaborative governance, if they invest in developing mechanisms to engage the public in more elements of the principled engagement dynamic, they might see gains in their capacity for joint action. One example of an investment in the *discovery* element could be the use of landscape value mapping (Brown and Reed 2009), a GIS-based tool that allows land managers to identify the areas on the landscape that community members value, along with better understanding of what exactly is particularly valuable to them about each area. In developing this tool, Brown and Reed illustrated it to be useful on the Central Oregon landscape in the Deschutes National Forest, though I found no evidence that this information is known or used by

wildfire managers, and Brown and Reed's assessment is now 15 years old in a region experiencing rapid population growth.

Another element of principled engagement, *deliberation*, should involve robust debate and therefore should include stakeholders of all types of the Central Oregon public. While the public is allowed to participate in the forest collaboratives in theory, in practice I did not observe this to happen frequently or with a diverse group of community members. In contrast, Parkins and Mitchell (2005) advocated for incorporation of public debate in natural resource management, specifically recognizing the importance of "inclusion" instead of "representation" in decision-making. In this context, they referred to representation as ensuring that all relevant ideologies are incorporated into decisions, whereas inclusion involved active solicitation for individuals to participate in the decision-making process. Tuler and Webler (1999) studied an empirical example of public debate in New England forest management, and identified seven principles to guide the design and implementation of public forums: access to the process, power to influence processes and outcomes, access to information, structural characteristics to promote constructive interactions, facilitation of constructive personal behaviors, adequate analysis, and enabling of future processes– all of which should be considered when including the public in natural resource management.

The application of these principles would lead to public engagement in making *determinations*, the final element of principled engagement. According to Emerson et al.

(2012), determinations can and should be substantive, including making recommendations and agreeing on actionable items, but can also be procedural, like setting an agenda, assigning a working group, or deciding to table a discussion. If managers wish to more impactfully involve the public in regional wildfire management decisions, they could create a public forum designed around the seven principles identified by Tuler and Weber (1999), while also maintaining the forest collaboratives as working groups more focused on including organizations that implement wildfire risk mitigation projects. In addition to increasing capacity for joint action, inclusion of the Central Oregon public in the planning process could further strengthen trust between managers and the community. Leena et al. (2019) discussed how public trust in an organization can easily slip if that organization is only invested in engaging with community leaders, rather than the broader community itself. Continuing to build trust with the public itself will be beneficial for managers, because trust and social capital are key for reducing transaction costs (Jones et al. 1997; Koppenjan and Klijn 2004; Emerson 2012). Reduced transaction costs will further enable collaborative action.

As the hundreds of millions of dollars recently allocated by the federal and state governments for community wildfire-adaptations begins to flow into Central Oregon, managers should look for the most efficient ways to effectively use resources. A collaborative process for managing regional wildfire risk that is more inclusive of the Central Oregon public might see better results in mobilizing public leadership, knowledge, and resources. To most effectively leverage these resources, managers need

to reconsider the roles of each stakeholder, including unaffiliated members of the public, and expand the collaborative group by casting a wide net to include a large portion of the Central Oregon public. Future research could focus on identifying currently included or excluded peoples as managers scale up wildfire risk mitigation efforts in the region.

4.5. Limitations

While this study took a close look at the collaborative relationships between regional wildfire managers and the Central Oregon public, it did not focus on the collaborative relationships between the numerous organizations involved in regional wildfire risk mitigation. The importance of relationships between organizations is not to be understated. For instance, expanding the collaborative governance regime to be more inclusive of the public could involve organizations leveraging partnerships with each-other to engage with the public in different ways throughout the collaborative process, like one organization focusing on education initiatives while another is responsible for organizing public forums to garner input. Another limitation of this study is a small sample size. It is possible that with a sample size of 13, an individual or organization that plays a unique role in engaging with the public could have been left out. Finally, in this research, I engaged exclusively with professionals working on regional wildfire risk mitigation, and I did not interface with the broader public, so their thoughts about their inclusion in collaborative wildfire risk mitigation were not directly considered.

5. CONCLUSIONS

In this project, I shed light on the current ways through which Central Oregon wildfire managers engage with the public. I found that wildfire managers allow the public to shape projects through two primary mechanisms: one mechanism facilitates the inclusion of very specific feedback through formal processes like federally-required public comment periods, and another mechanism sometimes compels managers to modify project design and implementation to avoid tarnishing their organization's reputation in the community. Managers sometimes include specific feedback from the public when it is relevant, justified, and feasible, but they often choose to exclude this feedback because, (1) the individual making the comment may not understand predetermined goals, policy frameworks that govern projects, ecological context, etc., or (2) the public may be upset about an unpopular aspect of a project, but that discontent is likely to fade quickly as the public adjusts to new conditions on a changing landscape. Wildfire managers prioritizing their organization's reputation in the community, though, is a more consequential way that the public influences Central Oregon wildfire risk mitigation work. Public trust in an organization can allow managers to move barriers like government regulations, but it can also constrain the work that managers do, as managers frequently adjust projects to provide minimal undesired effects to the community. Maintaining public trust is important to wildfire managers because lack of trust in an organization can lead to litigation that delays or stalls projects.

Leveraging collaborative governance theory, I identified ways through which wildfire managers in Central Oregon might be able to increase adaptive capacity by leveraging latent assets from the public like leadership, knowledge, and resources. This could most likely be achieved by involving the public more directly in the collaborative process, namely through clear dialogue about values in the region, active debate about wildfire risk mitigation in the context of those values, and empowerment in decision-making processes. By applying collaborative governance theory to regional wildfire risk mitigation efforts, I also connect regional wildfire management with a broader range of natural resource management literature that discusses similar concepts found in collaborative governance. Finally, I advocate for the replacement of the term "social license" with "social capital" to encourage wildfire managers and communities reconsider the nature of their relationships and each stakeholder's relative influence in designing wildfire-adapted communities.

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Paper II: Framing Wildfire Risk: an Empirical Study of the Thread Between Cultural Subcontext, Visions of Nature, and Natural Resource Management Priorities

ABSTRACT

Issues associated with wildfire are connected to numerous ecological and social systems. The diversity of these issues elicits divergent understandings of wildfire risk depending on what individuals perceive as the primary risk, and these perceptions are rooted in culture. As a growing amount of resources are allocated to facilitate community adaptations to wildfire, emergent questions about the diverse cultural perceptions of wildfire risk need to be addressed, as they pertain to the design of wildfire-adapted communities. The role of culture in shaping natural resource management has long been theorized, but empirical studies are lacking. Using the lens of collaborative governance theory and data from two surveys of regional wildfire managers in the Western United States, I characterize this role by testing two potential frameworks for representing cultural perceptions of risk. I found that a commonly used framework rooted in cultural theory did not illustrate a connection between cultural perceptions of risk and wildfire managers' priorities, while a novel framework for understanding cultural perceptions demonstrated influence over managers' attitudes about inclusionary practices in planning. I discuss the advantages of this framework and the information that my empirical findings provide about cultural perceptions shaping collaborative resource management, which are tied to views of stakeholder legitimacy and inclusion.

1. INTRODUCTION

1.1. Characterizing the issue(s) of wildfire in the West

Wildfire risk has been described as a "socio-ecological pathology," an issue with severe implications that are far-reaching across a range of social and environmental fields and no clear solution to satisfy all stakeholders (Fischer et al. 2016). Across Western North America, community exposure to wildfire has been an issue growing in scope and severity since the late 20th century, with longer fire seasons, a growing number of acres burned, and annual losses to wildfire continuing to increase, despite ballooning suppression costs (Bayham et al. 2022; Jolly et al. 2015). Beyond the cost of damages and suppression, the expanding wildfire crisis is tied to countless other issues, both ecological and social. This is certainly not to say that all wildfire adversely impacts these issues, as wildfire of appropriate intensity and acreage has countless benefits (e.g. Tedim et al. 2020; Mutch 1970; Keane and Karau 2010; Gómez-González et al. 2010; Milne et al. 2014), but changing wildfire regimes combined with human settlement in the last two centuries have created a situation where negative impacts of wildfire are rife.

Similar to any other contemporary issue, stakeholders might hold a range of views about the issue of wildfire, depending largely on underlying cultural context. For example, discussions about wildfire with various people might show some to be primarily concerned with losses of homes and communities, others might lament damages to ecosystems and biodiversity (e.g. Rockweit et al. 2017) or impacts to drinking water (e.g. Hohner et al. 2019), and some might consider risk from wildfire as an inevitable

consequence of human development in the wilderness (e.g. Chen and Yin 2022). Because issues associated with wildfire risk are so expansive, individuals might view wildfire in a number of different ways based on their way of looking at the world, i.e. their culture (Greider and Garkovich 1994; Wilson 1997).

There is certainly no exhaustive list of the issues associated with wildfire, but in this paper I discuss many of them using several broad categories including hazards to human development, ecological degradation and restoration, climate change, human expansion into wildfire-prone landscapes, human health, and equity/environmental justice. First of all, the issues relating to wildfire that put human assets at risk are abundantly clear, with an estimated 97,000 structures in the United States destroyed from wildfire between 2005 and 2022 (Barrett 2022)– structures that include houses, schools, community centers, and countless other facilities that people rely on to lead fulfilling lives. Defending these structures has typically been a high priority for policymakers and land managers. Another set of issues related to wildfire, ecological degradation, has in some senses been occurring across Western North America since colonization and westward expansion in the 19th century. Many of the American West's forests historically were subjected to fuel-limited wildfire regimes, meaning low-intensity fires burned frequently. Emphasizing timber production, colonists in the 19th and 20th centuries attempted to suppress every wildfire and implemented plantation forestry. As a result, forests have become dense and homogenous, a major shift from the sparse and heterogeneous forest structures previously maintained by Indigenous peoples. This novel forest structure has

contributed to an increase in the number and acreage of high-severity wildfires (Zald and Dunn 2018; Evers et al. 2022), and those fires have further degraded ecosystems (Dove 2020). Many are now advocating for ecosystem restoration that includes components of wildfire risk mitigation, like hazardous fuels reductions (USDA Forest Service 2022).

In addition to novel forest structures, there is much evidence that indicates that issues related to climate change also drive changing wildfire regimes. For example, more common droughts and changes to atmospheric vapor pressure deficit are causing areas to shift between moisture-limited and fuel-limited wildfire regimes (Hanan et al. 2021; Williams et al. 2019). This link has led some to believe that action on climate change is crucial to mitigate wildfire risk (Schulte and Miller 2010). Other well-documented drivers of wildfire risk are issues stemming from post-colonial human expansion into wildfire-prone areas. There are two elements that describe how human encroachment increases wildfire risk: 1) increased human activity in dry landscapes has been at the root of most recent wildfire ignitions (Syphard et al. 2007), and 2) development of communities in wildfire-prone areas inherently places all of those assets at risk (Radeloff et al. 2018).

On the other hand, the Indigenous peoples who originally inhabited fire-prone landscapes relied on fire to maintain healthy lifestyles by increasing biodiversity, maintaining ecosystem services, and diversifying food sources, considering fire vital for health. In today's setting, though, most people focus on the adverse impacts of wildfire to human

health, including respiratory illness from smoke exposure (Reid et al. 2016) and degradation of drinking water quality (Hohner et al. 2019). Along with health issues, adverse impacts to socioeconomic well-being from wildfire are felt disproportionately by different peoples, largely based on their ability to prepare for, respond to, and recover from a wildfire, raising equity concerns. For example, many working class residents may not be able to stay indoors to reduce smoke exposure, afford accommodations during an evacuation, or afford to rebuild a destroyed home, compared to those that Collins and Bolin (2009) labeled "amenity migrants," who they said typically can afford to take time off work, travel out of town to stay with others during an evacuation, and rebuild after losing a home (or can afford to not rebuild, if they own more than one house). As they pertain to wildfire, these inequities can be spatially quantified (Palaiologou et al. 2019) and risk mitigation efforts can be targeted to reduce risk for those with the greatest need.

The range of issues associated with wildfire is diverse, and different people primarily see several, but not necessarily all, of these issues, depending on their cultural perspectives (Fischer and Russo 2022; Wilson 1997). To address a number of these issues, people who work to manage wildfire risk at a regional scale ("wildfire managers") collaborate to cultivate "wildfire adapted communities," or communities that are more resistant to and resilient from negative impacts of wildfire. Different conceptions of wildfire risk held by each community member and stakeholder can complicate these efforts, and vital questions fall at the intersection of wildfire management professionals and other stakeholders at large: who should have input into designing wildfire adapted

communities, and how do wildfire managers decide who to invite into the collaborative process?

1.2. Public engagement in natural resource management

In the 1960s, at the beginning of the environmentalism movement in the United States, public frustration was growing with regards to the dominant practice of "expert-driven" natural resource management, which generally included negligible input from the communities that surrounded managed areas (Allen and Gould 1986; Rittel and Webber 1973). Legislation passed in the 1970s mandated specific public engagement practices for projects on federal lands with the intention of standardizing the inclusion of public opinion in resource management, but discontent in communities about lack of influence remains (Lachapelle et al. 2003). For example, the Northwest Forest Plan was created by the United States Forest Service in the 1990s with a goal of building agency-citizen collaboration in forest management, but Charnley (2006) found that goal to be unfulfilled. Frentz et al. (2000) illustrated that technocratic public comment processes are barriers to the solicitation and inclusion of public input, which has caused members of the public to feel disempowered and distrust land management agencies. Because of the diversity among both managers and communities, there are no clear best practices for the inclusion of public input in natural resource management decisions (Paveglio et al. 2015, 2018).

Wildfire managers understand the importance of connecting with members of the

communities where they operate (Madsen et al. 2018; Shindler et al. 2014). Many refer to the need for "social license" to be given by nearby communities in order to continue active management (e.g. Kelly et al. 2019). Social license, which can be conceptualized as a function of community trust in agencies, has no well-accepted definition, but typically references a community's acceptance of industrial activities, especially for extractive industries like mining or timber harvest (Kendal and Ford 2018). Notably, maintaining social license does not necessarily require the solicitation or inclusion of public input in planning. Still, wildfire managers rely on mutually beneficial relationships with communities for risk reduction work to proceed in the face of public concerns over environmental, sociocultural, and economic issues (see Paper I), yet there is disagreement among managers about precisely how much influence the broader public should have over wildfire management. Indeed, Billgren and Holmén (2008) argued that the level of participation each stakeholder is allowed in collaborative natural resource management is selective, based on ideas of stakeholder legitimacy and power. More specifically, the root of wildfire managers' disagreement over the proper amount of public influence is yet unclear, however some scholars have suggested that underlying concepts of culture might influence how managers determine who is a legitimate stakeholder and collaborate with others.

1.3. Culture and natural resource management

1.3.1. Culture shapes perceptions of nature and how we interact with it

Greider and Garkovich (1994) characterized a "landscape" as being a symbolic

environment that is entirely crafted by human conceptions of nature and the environment– conceptions that are self-defined within one of many cultural subcontexts. In other words, people perceive the physical environment as a landscape composed of socially constructed phenomena that are self-defined based on their culture. "Culture" as a concept has eluded universal definition, but in the Routledge Companion Encyclopedia of Anthropology, Ingold (1994) explained typical understandings of culture as representing "structures of symbolic meaning" that constitute a "shared system of concepts or mental representations" (Ingold 1994, p. 329). Pendergraft (1998) illustrated this sentiment in the context of natural resource management, claiming that "alternative assumptions about the nature of the world, about the nature of man, and about the nature of the relationship between man and the world, derive from the underlying structures we call culture" (Pendergraft 1998, p. 644). He used the example of the biosphere to illustrate how, despite shared goals, different viewpoints impact management, explaining that while nearly everybody shares a goal of maintaining a healthy biosphere, divergent ideas about what constitutes "healthy" are shaped by individuals' understandings of what is real, what is right, and what is equitable.

Wilson (1997) further illustrated this idea using the example of the famous reintroduction of wolves into Yellowstone. Ecologists and environmentalists widely hailed the wolf reintroduction as a success, yet controversy over the project remains, especially among nearby landowners who primarily view the wolves as threats to their livelihoods. The ecologists and environmentalists, on the other hand, primarily view the wolves as a

keystone species that is vital to the balance of the ecosystem. Both understandings of the issue are true, yet the practical implications of the two ideas are vastly different. Again, Wilson attributed this conflict to differing conceptions of nature. He proposed that all stakeholders yearn for a healthy landscape, but competing ideas about what constitutes a "healthy landscape" has led to disputes about best management practices. Billgren and Holmén (2008) attributed these differences to culture, claiming that determining exactly what is at stake (and accordingly, deciding on best management actions) is shaped by individuals' views of what nature is, and that those views are grounded in culture. In sum, many scholars have suggested that underlying culture impacts understanding and management of natural resources, but empirical literature illustrating the link and explaining *how* cultural perspectives shape collaborative processes is severely lacking due to the absence of theory that adequately represents the roles of culture and divergent conceptions of nature in stakeholder decision-making.

1.3.2. Cultural theory

Cultural theory is one framework that has been frequently used to explain differences in perceptions of the world, especially those pertaining to various types of risk. Developed through the late 20th century, cultural theory has been widely used to explain how different groups of people respond to risk, including by building capacity for organizations (formal and informal) to regulate risk (Tansey and O'Riordan 1999; Douglas 1978, 1982; Thompson et al. 1990; Dake 1991). The theory was initially posed by Douglas (1978, 1982) to demonstrate that individual and collective responses to risk

are not only shaped by concerns of safety, but also underlying social and cultural contexts regarding power, legitimacy, and the nature of society. Prevailing interpretations of the theory assert that individuals and organizations can be understood as having one of four worldviews, depending on their "group" score (representing their view of whether risk is borne collectively or individually) and their "grid" score (representing their view of whether risk is managed collectively or individually): *individualists* tend to view risk as being borne by individuals and believe that the responsibility of managing that risk falls to the individual; *egalitarians* view risk as being held collectively by some segment of society while management responsibility falls to individuals; *fatalists* view risk as being held individually but managed collectively; and *hierarchists* view risk as being both held and managed collectively.

In the context of natural resource management, cultural theory has been used frequently to apply perceptions of nature to groups of people based on their worldview, with most scholars agreeing that fatalists view nature as capricious, hierarchists view it as as tolerant, egalitarians as ephemeral, and individualists as benign (e.g. Billgren and Holmén 2008) (Figure 3). Billgren and Holmén (2008) further claimed that because "different categories of stakeholders embody different perceptions of nature" (Billgren and Holmén 2008, p. 550), cultural theory might help explain levels of stakeholder involvement in collaborative natural resource management. That is to say, some stakeholders are more or less likely to be involved in collaborative natural resource management depending on their views about nature, which are shaped by their worldview

as an individualist, hierarchist, egalitarian, or fatalist. Hoogstra-Klein et al. (2012) also posited that differing views of reality and cultural biases may impact collaborative management, and they attempted to apply cultural theory empirically to natural resource management as a tool to predict individual stakeholders' actions. They found that it was possible to determine the worldviews of the individual stakeholders they studied, but those worldviews did not explain stakeholders' actions in forest management. Ultimately, they concluded that "cultural theory, the way it is used now, is not the instrument that will help us solve the problems in participatory processes" (Hoogstra-Klein et al. 2012, p. 99). Thus, another approach is necessary for understanding the influence of culture on natural resource management.

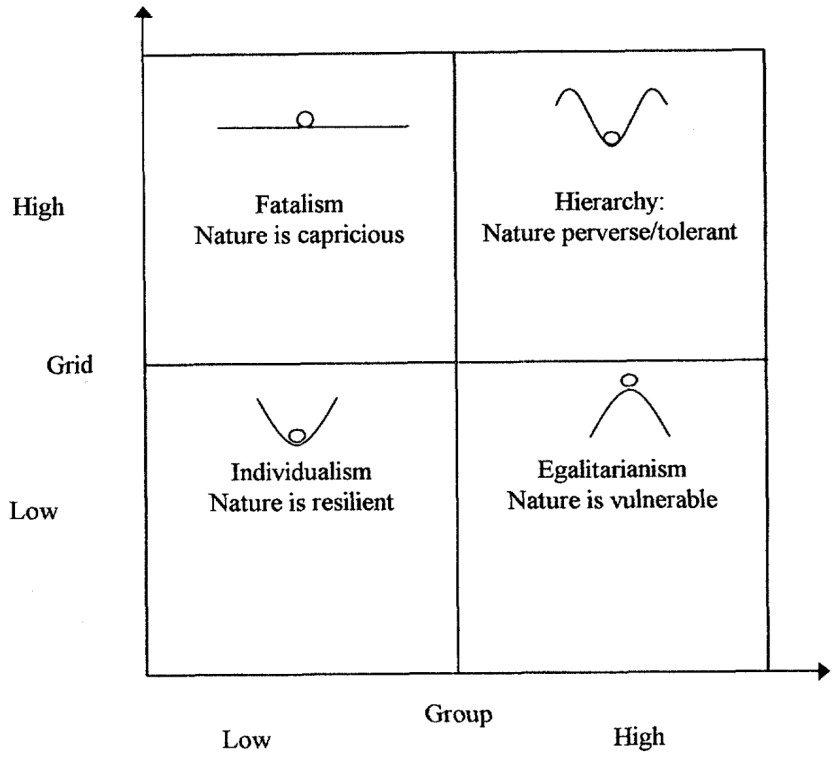

Figure 3: a chart reflecting a commonly accepted theory about peoples' views of nature as a function of their worldview. Individualists tend to view nature as resilient, egalitarians view it as vulnerable, hierarchists as tolerant, and fatalists as capricious (from Tansey and O'Riordan 1999).

1.3.3. Critiques of cultural theory and future directions

Billgren and Holmén (2008) critiqued that in cultural theory, worldviews are often attached to organizations, but the individuals who comprise those organizations have their own non-identical worldviews, asserting that "cultural theory has been used to squeeze stakeholders into inflexible categories" (Billgren and Holmén 2008, p. 558). Ultimately, they argue that individual cultural viewpoints must be taken into consideration when studying collaborative natural resource management. In another rebuke of the application of cultural theory to natural resource management, Stedman (2003) applied structural equation modeling to a dataset of 1,000 surveys of property owners in the United States to craft a model that integrated physical environmental variables with other variables that reflected socially-constructed sense of place, and found that both sets of variables played a role in explaining the meanings that landowners applied to the physical environment. Individuals' perceptions of the environment are grounded both in physical landscape attributes and socially-constructed concepts, and thus cannot be explained by rigid ideas that people with one socially-constructed worldview see all of nature in one particular way. Some scholars who have written about cultural theory have theorized that individuals might have a "multiple self," invoking different cultural perspectives under different circumstances like working or recreating (e.g. Billgren and Holmén 2008; Thompson et al. 1990; Grendstad and Selle 1995). Even Douglas (1982) pondered whether individuals belong to multiple cultural groups, but prevailing applications of cultural theory rely on assigning one worldview to each individual. In practice, though, individuals might have multiple lenses through which

they frame natural resource issues, and those lenses are likely a function both of social constructs and physical aspects of the specific issue at hand.

An alternative approach to assessing culture in natural resource management might consider culture as reflecting both physical and social aspects of a specific issue, and that individuals might hold more than one view about the issue. Dewulf and Bouwen (2012) described the concept of "issue framing," which aligns with these criteria. Issue framing considers how diverse individuals regard a single issue as having divergent implications. Considering the various lenses through which individuals, groups, and organizations frame an issue allows for the achievement of mutual understanding ("mutual understanding" referring to the recognition among stakeholders of where each-other stands on an issue, not to be confused with "common understanding" which would refer to stakeholders framing the issue in the same way). This concept can be understood as being reflective of culture as characterized by Ingold (1994) with distinct frames representing the symbolic meanings held through shared systems of mental conceptions. Issue framing has been successfully applied in natural resource management (Davies et al. 2016; Davies et al. 2017; Sisneros-Kidd et al. 2019), and Fischer and Russo (2022) inductively identified a series of frames specific to the issue of wildfire management. Issue framing might prove useful for understanding the role of culture in wildfire risk mitigation.

1.4. Collaborative governance theory as a framework

Rather than develop a novel theoretical framework to characterize the role of culture in resource management, I expand on an existing framework that includes (but does not yet adequately explain) culture in collaborative resource management. Collaborative governance theory is a framework often applied to issues in collaborative natural resource management, but to date, the role of culture in shaping collaborative processes has not been empirically examined in the framework, nor has much attention been paid to it theoretically. The theory represents the processes through which a variety of stakeholders engage with each-other to build capacity to manage their communities and resources (Figure 4). Specifically, collaborative governance theory captures the policy-development social structure through which stakeholders and policymakers collaboratively address shared goals while grappling with stakeholders' different priorities, resources, and levels of power in policy-making (Ansell and Gash 2007; Emerson et al. 2012).

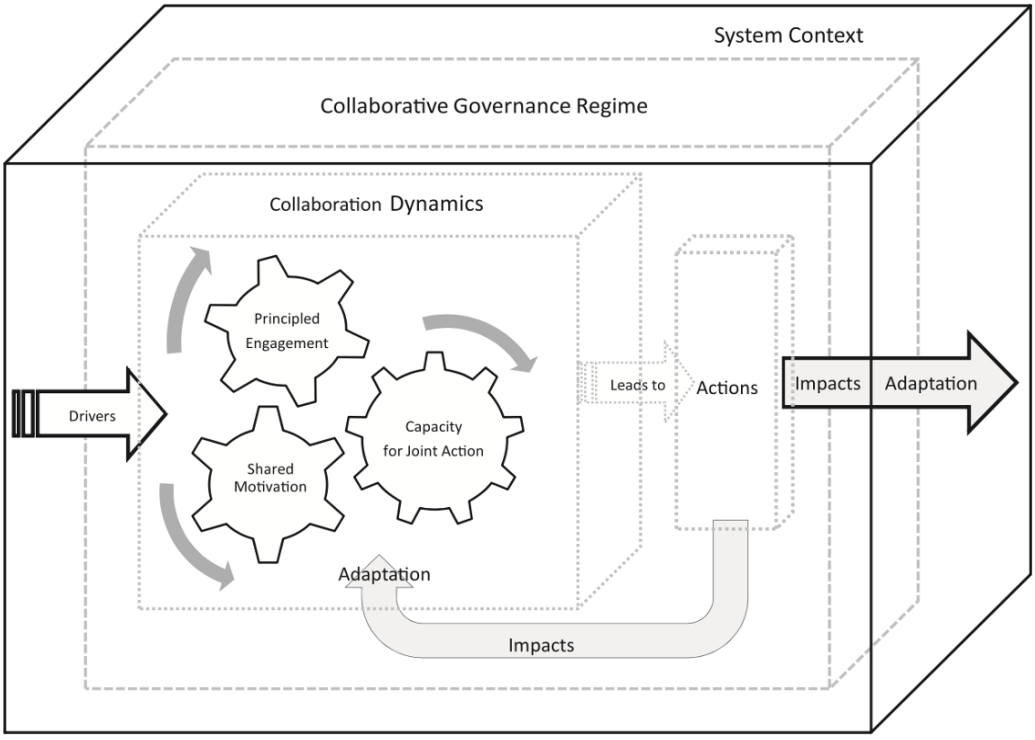

Figure 4: a conceptual model of a collaborative governance regime according to Emerson et al. (2012). The entire collaborative governance regime exists inside of the system's context. Drivers spark collaborative efforts, and those efforts are shaped by collaborative dynamics. Those efforts may lead to actions, which have impacts on both the collaborative process and the system context. Based on those impacts, the collaborative governance regime will adapt to the new context.

Collaborative governance theory provides explanations of how diverse values and priorities among stakeholders impact collaborative processes, but does little to explain how differing cultural perspectives regarding the nature of resources and issues at hand affect the collaborative process. In their model of the theory, Emerson et al. (2012) included "socioeconomic and cultural health and diversity" as an element of the system context, but did not explain the concept and did little to illustrate how culture impacts a collaborative governance regime. I hypothesize that culture may play a significant role in determining who is or is not invited to collaborative processes and how large or small their influence may be, and I test that hypothesis in this study.

1.5. Research objectives

A large body of literature suggests that culture likely impacts natural resource management (Wilson 1997; Billgren and Holmén 2008; Hoogstra-Klein et al. 2012; Tansey and O'Riordan 1999), but it is unclear how. Some researchers have attempted to apply cultural theory to explain the link, but those attempts so far have demonstrated that cultural theory is not the right tool. In contrast to cultural theory, I hypothesize that a better approach will 1) attribute culture not to organizations, but to the individuals that comprise them; 2) consider culture as it pertains to specific issues, rather than broad, generalizable worldviews; 3) incorporate both physical and socially-constructed aspects of an issue; and 4) allow for multiple understandings of complex issues. In this study, I consider six different cultural lenses through which people might frame the issue of wildfire, and I test those lenses using data collected in two surveys of regional wildfire managers. I also assessed the managers' worldviews using cultural theory, and using linear modeling I compare the utility of both frameworks in explaining managers' attitudes about including public input in regional wildfire risk mitigation projects. Finally, I applied a series of difference of means tests to determine if wildfire managers holding one particular lens or worldview are significantly more or less likely to consider public input in wildfire management.

2. METHODS

2.1 Study area: wildfire risk mitigation in Central Oregon

There have been a few recent attempts in the United States to identify where communities

are at high risk to wildfire exposure. For example, Ager et al. (2021a) used a modeling approach to identify “firesheds” (for more on “firesheds” see Ager et al. 2021b) where wildfire poses significant risks to human developments, and the 2022 United States Forest Service’s Wildfire Crisis Strategy identified several high-risk firesheds in close proximity to land managed by the Forest Service (USDA Forest Service 2022; Evers et al. 2019). In several studies, the fire-prone region of Central Oregon in the United States (Figure 5) has been identified to be at high risk from exposure to wildfire (Fischer et al. 2016; Ager et al. 2022; USDA Forest Service 2022). This project focuses on Central Oregon, including all of Deschutes and Jefferson counties and parts of Crook county. Prior research has identified the members of the Central Oregon wildfire management network (Evers et al. 2021; Fischer and Jasny 2017; Spies et al. 2014), priming this region for study as a socio-ecological system.

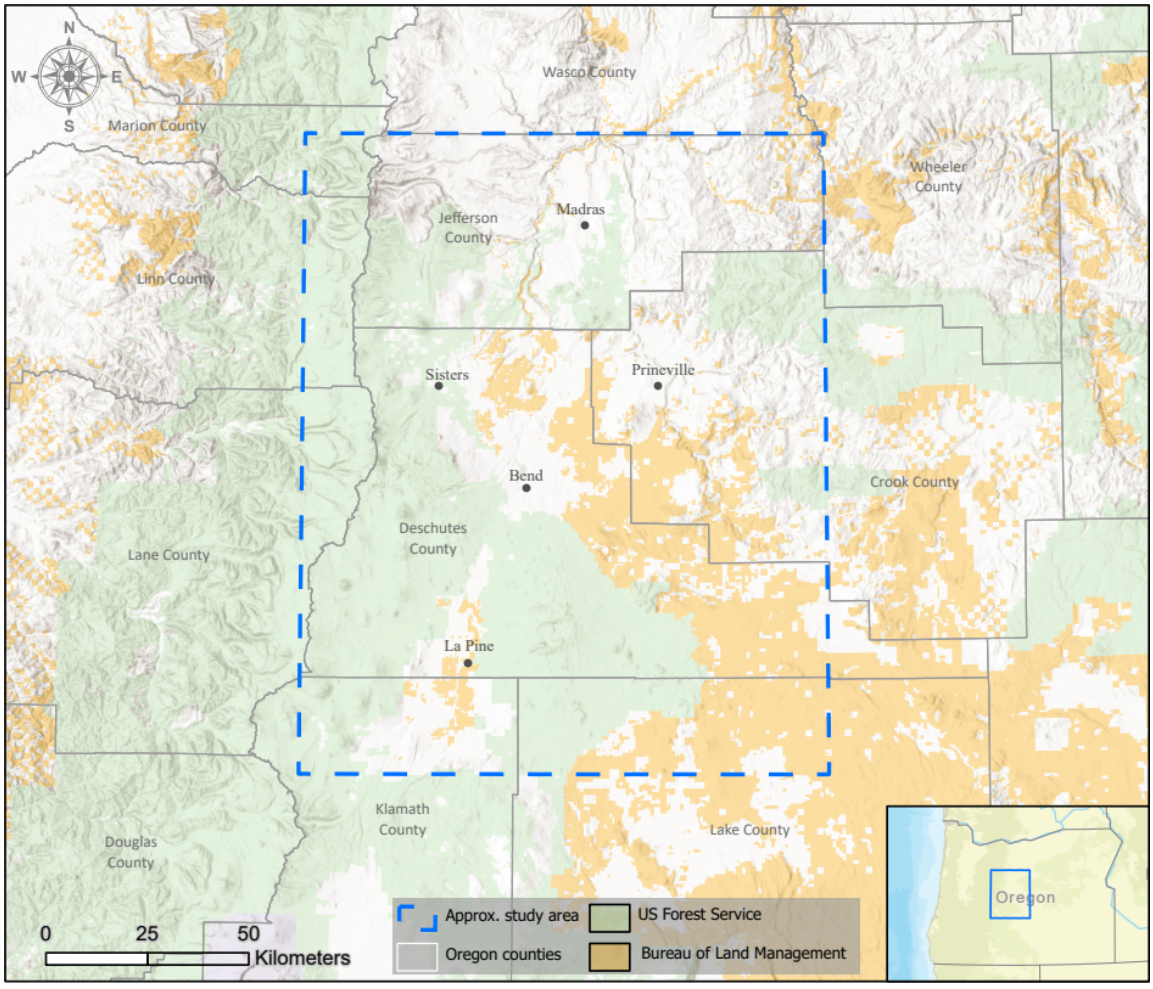

Figure 5: a reference map of the Central Oregon study area. Approximate boundaries are outlined in blue. Federal land is highlighted in light green (US Forest Service) and light orange (Bureau of Land Management).

Much of Central Oregon is sparsely populated, though there are some densely populated areas. The majority of the study area is encompassed by virtually unpopulated federal lands, like the Deschutes National Forest on the western side, the Ochoco National Forest on the northern and eastern sides, and Bureau of Land Management lands across the study area. The northern part of the region includes the Confederated Tribes of the Warm Springs Indian Reservation. In much of the region, sparsely populated private lands are interspersed throughout areas of federally-managed land. The city of Bend is the center of

commerce in the region, and the greater Bend area is home to over 100,000 residents– a number that is rapidly growing, as the city added nearly 30% to its population between the 2010 and 2020 censuses.

2.2. Identifying and understanding Central Oregon's wildfire management network

Understanding efforts to mitigate wildfire risk in Central Oregon warranted first identifying the network of individuals involved in collaborative wildfire risk management. To that end, I employed a two-survey workflow to identify individuals involved in regional collaboration. The first survey ("Phase I survey") was implemented in Spring 2021 by faculty at Portland State University (Evers et al. 2021). The survey used a chain referral technique to identify all individuals connected with others in the wildfire management network. Questionnaires were issued using Qualtrics, an online survey platform. Initial surveys were issued to members of a stakeholder advisory committee convened to guide research into wildfire risk mitigation. The questionnaire asked participants to list contact information for up to 20 individuals who they had collaborated with on wildfire-related projects over the last five years. Collaborators identified in each survey response were then recruited for participation via email and telephone and were issued the same survey. This process continued iteratively for ten rounds, when network saturation was achieved. The Phase I survey identified 211 individuals who collaborate to manage regional wildfire risk in Central Oregon. Of those, 116 responded to the survey: 30% of respondents worked for federal agencies like the United States Forest Service and the United States Bureau of Land Management, 17%

worked for county/municipal government, 14% worked for state agencies like the Oregon Department of Forestry and the Oregon State Fire Marshal, 14% worked for non-governmental organizations (NGOs), 13% worked for local fire departments, and 13% worked for other employers including the private sector, tribal government, and a university extension.

In the Spring of 2022, I implemented the second survey ("Phase II survey") with the goal of characterizing relationships between stakeholders in regional wildfire risk mitigation, again using the online survey platform Qualtrics (Resener et al. 2022; Appendix). I used the list of 211 collaborators identified in the Phase I survey as the basis for sampling. I removed from the sample those whose current work does not focus specifically on wildfire management in Central Oregon (N=37). This included individuals who work at the national scale, are retired or no longer working on wildfire risk mitigation in Central Oregon, or whose work is only tangentially related to wildfire risk mitigation. Once again, recruitment was completed via email and telephone. During the recruitment process, three new individuals were identified who had filled the positions of recently retired or relocated wildfire management network members. The final sample size was 177. Of those, 76 responded to the survey: 29% of respondents worked for federal agencies, 20% worked for local/municipal government, 17% worked for local fire departments, 16% worked for state agencies, 8% worked for NGOs, and 11% worked for other employers (private sector, tribal government, and a university extension). Across both surveys, there were 51 participants who completed all questions of interest for this

study, so the analysis below relied on data gathered only from those 51 individuals.

2.3. Data and measures

2.3.1. Measuring the importance of public input in wildfire managers' decisions

I designed a question in the Phase II questionnaire to assess the importance of public input in managers' decision-making. The question asked participants to respond to six statements about public influence over wildfire risk mitigation using a five-point Likert scale, ranging from "strongly disagree" to "strongly agree." I conducted an exploratory factor analysis to identify the items that best represented the amount of public influence over managers' decision-making, and found two factors. Factor 1 included four items with loadings greater than 0.4 and a Cronbach's Alpha of 0.56, and Factor 2 included one item with a loading greater than 0.4 (Table 2). Despite an enigmatic Alpha, I selected the four items in Factor 1 to be averaged into an index called "public influence" based on acceptable factor loadings. This index served as the dependent variable for my analysis.

Table 2: factor loadings of exploratory factor analysis for six statements designed to measure wildfire managers' self-described likelihood to include public input in wildfire risk mitigation projects. Together, four of these six statements achieved one factor with loadings greater than 0.4, and accordingly, they can be understood together as representing the idea at hand. Loadings less than 0.4 are not reported. Data are from the Phase II survey of wildfire managers in Central Oregon.

Statement:	Factor 1:	Factor 2:	Percent responses of "agree" or higher:
Managers who prioritize community relationships are more successful at managing fuels in Central Oregon.	**0.75**	–	**94%**
Public support is necessary for managing fuels in Central Oregon.	**0.55**	–	**96%**
Managers should prioritize areas where the public demand for fuels treatments is the greatest.	**0.45**	–	**57%**
Public opinion is not important for fuels management in areas not visible to the broader public. (reverse coded)	**0.44**	–	**92%**
Managers should not conduct a fuels management project unless nearby community members approve.	–	**0.43**	**25%**
A single community member can derail a fuels management project even if most stakeholders are on board.	–	–	**55%**

2.3.2. Assigning cultural theory worldviews to wildfire managers

The Phase I questionnaire included a set of 12 statements that, using the cultural theory framework, have been commonly used to assign one of four potential worldviews to respondents (individualist, hierarchist, egalitarian, and fatalist), using a method similar to the one developed by Dake (1991). Participants were asked to respond to the 12 statements using a seven point Likert scale, ranging from "strongly disagree" to "strongly agree." Three statements each corresponded to one of the four potential worldviews, and exploratory factor analysis confirmed that in practice, each set of statements measured one worldview, as intended (Table 3). Cronbach's Alpha for each of the worldviews were

0.78, 0.76, 0.81, and 0.73 for individualists, hierarchists, egalitarians, and fatalists, respectively. This validates the application of these worldviews to individual managers. I assigned one worldview to each respondent by averaging the three values associated with each potential view and selecting the worldview with the highest score. Then, I created a variable for each of the four worldviews and populated each field with a "1" if a respondent was assigned that worldview and a "0" if they were not. Eight individuals held two worldviews that tied for the highest score, and in those cases I assigned both views. In total, the sample of 51 included 39 egalitarians, 10 hierarchists, 8 individualists, and 2 fatalists.

Table 3: factor loadings of exploratory factor analysis for 12 statements designed to measure the four worldviews according to cultural theory. All statements were factored into their intended groups, indicating that the 12 statements are appropriate measures of the four worldviews. Loadings less than 0.4 are not reported. Data are from the Phase I survey of wildfire managers in Central Oregon (Evers et al. 2021).

	Statement:	Factor 1 (individualism)	Factor 2 (fatalism)	Factor 3 (hierarchism)	Factor 4 (egalitarianism)
Individualism Cronbach's α = 0.78	Even if some people are at a disadvantage, it is best for society to let people succeed or fall on their own.	**0.81**	–	–	–
	We are all better off when we compete as individuals.	**0.69**	–	–	–
	Even the disadvantaged should have to make their own way in the world.	**0.64**	–	–	–

	Statement:	Factor 1 (individualism)	Factor 2 (fatalism)	Factor 3 (hierarchism)	Factor 4 (egalitarianism)
Fatalism Cronbach's α = 0.73	Most of the important things that take place in life happen by random chance.	–	**0.82**	–	–
	No matter how hard we try, the course of our lives is largely determined by forces outside our control.	–	**0.70**	–	–
	It would be pointless to make serious plans in such an uncertain world.	–	**0.57**	–	–
Hierarchism Cronbach's α = 0.76	Our society is in trouble because we don't obey those in authority.	–	–	**0.86**	–
	The best way to get ahead in life is to do what you are told to do.	–	–	**0.66**	–
	Society would be much better if we imposed strict and swift punishment on those who break the rules.	–	–	**0.62**	–
Egalitarianism Cronbach's α = 0.81	It is our responsibility to reduce the differences in income between the rich and poor.	–	–	–	**0.71**
	What our society needs is a fairness revolution to make the distribution of goods more equal.	–	–	–	**0.70**
	Society works best if power is shared equally.	–	–	–	**0.67**

2.3.3. Measuring and assigning wildfire frames

In the Phase II survey, I included a series of 18 statements that I, along with four other researchers, devised to represent six potential lenses through which individuals might frame the issue of wildfire, based on work presented by Fischer and Russo (2022). I refer to these as "wildfire frames." Wildfire frames are not mutually exclusive because wildfire

relates to a complex set of socio-ecological issues, and most people understand the implications of wildfire in more than one setting. Individuals who view wildfire as an issue of *restoration* see that ecosystems in some fire-prone areas are out of balance and believe that landscape restoration and hazardous fuels reduction are necessary to restore order. Those who view wildfire as an issue of *life* understand that in many areas, fire is an essential part of the landscape and is necessary for the health of humans and wildlife. Some view wildfire as an issue of *equity* and acknowledge that issues related to wildfire impact some groups of people more than others, believing that wildfire risk mitigation efforts should be targeted to assist those who need it most. People who view wildfire as an issue related to *climate* draw a connection between climate change and novel wildfire regimes, and typically recognize that action to slow climate change is necessary to mitigate wildfire risk. Some individuals understand wildfire as a natural system, framing it as a *wilderness* issue and typically advocating for a hands-off approach to forest management. Finally, those who view wildfire as a *hazard* know the human values at risk and prioritize actions to reduce wildfire risk around communities and infrastructure.

Of the 18 total statements pertaining to wildfire frames in the Phase II survey, three were associated with each frame. Participants were asked to respond to each statement using a five point Likert scale, ranging from "strongly disagree" to "strongly agree." Exploratory factor analysis identified six factors, with three items each corresponding to one of the six different frames as intended, with two exceptions: one statement in the *hazard* group and one statement in the *life* group did not achieve a factor loading of at least 0.4 (Table 4).

Cronbach's Alpha for each frame was calculated as 0.73, 0.70, 0.78, 0.79, 0.81, and 0.59 for *restoration*, *life*, *equity*, *climate*, *wilderness*, and *hazard*, respectively. While Alpha for the *hazard* frame was questionable, when taken together, these scores confirm the validity of applying wildfire frames to individual managers. To assign frames to respondents, I averaged each individual's responses to the three statements that represent each frame and assigned a frame if the individual responded with an average value of "agree" or higher. Then, I created a variable for each of the six wildfire frames and populated each field with a "1" if a respondent was assigned that frame and a "0" if they were not. Of the 51 responses analyzed here, 46 wildfire managers framed wildfire as a *restoration* issue, 29 as a *climate* issue, 29 as an *equity* issue, 17 as an issue of *life*, 13 as a *wilderness* issue, and 6 as a *hazard*.

Table 4: factor loadings of exploratory factor analysis for 18 statements designed to measure six wildfire frames. With two exceptions, all statements loaded at levels greater than 0.4 in their intended groups, indicating that the 18 statements are appropriate measures of the six wildfire frames. Loadings less than 0.4 are not reported. Data are from the Phase II survey of wildfire managers in Central Oregon.

	Statements	Factor 1 (wilderness)	Factor 2 (climate)	Factor 3 (restoration)	Factor 4 (equity)	Factor 5 (hazard)	Factor 6 (life)
Wilderness Cronbach's α = 0.81	*We should let wildfires burn where they naturally occur.*	**0.82**	–	–	–	–	–
	Natural processes like wildfire are the best managers of forests.	**0.71**	–	–	–	–	–
	Our forests need more wildfire, not less.	**0.67**	–	–	–	–	–
Climate Cronbach's α = 0.79	*Wildfire is a crisis because of climate change.*	–	**0.82**	–	–	–	–
	Wildfire mitigation attempts are insufficient without action on climate change.	–	**0.81**	–	–	–	–
	Increased drought in the future will lead to more catastrophic fire.	–	**0.75**	–	–	–	–
Restoration Cronbach's α = 0.73	*Management activities should prioritize fuel reduction.*	–	–	**0.81**	–	–	–
	We need to increase the pace and scale of fuel reduction activities.	–	–	**0.74**	–	–	–
	Forests are becoming increasingly dense with fuels (flammable biomass).	–	–	**0.56**	–	–	–

	Statements	Factor 1 (wilderness)	Factor 2 (climate)	Factor 3 (restoration)	Factor 4 (equity)	Factor 5 (hazard)	Factor 6 (life)
Equity Cronbach's α = 0.78	*Responding to the risk of wildfire is an issue of equity and environmental justice.*	–	–	–	**0.76**	–	–
	We can't address wildfire risk without reforming public health, insurance, and emergency services.	–	–	–	**0.75**	–	–
	Wildfire has affected some groups of people more than others.	–	–	–	**0.72**	–	–
Hazard Cronbach's α = 0.59	*Wildfires need to be suppressed to protect people's livelihoods*	–	–	–	–	**0.94**	–
	Wildfire is a threat to human development that needs to be suppressed.	–	–	–	–	**0.81**	–
	The risk of wildfire is primarily to homes and infrastructure.	–	–	–	–	–	–
Life Cronbach's α = 0.70	*Cultural burning was once an important practice in my community.*	–	–	–	–	–	**0.79**
	For generations, fire has been a vital part of life in my community.	–	–	–	–	–	**0.71**
	Fire is necessary for food, water, and wildlife in my community.	–	–	–	–	–	–

2.4. Data analysis

To understand the influence of culture on wildfire manager's attitudes about public input

in wildfire risk mitigation, I used multiple regression to craft a set of three linear models, using the "public influence" index as the response variable for each. In one model, I included the four variables associated with the cultural theory worldviews to represent culture. In the second model, I used the six variables associated with the wildfire frames to represent culture. In a third model, I included the wildfire frames to represent culture, but reduced the model using a stepwise method to demonstrate the best potential explanatory power of cultural variables. I attempted to create a reduced model using the four cultural theory variables, but no variables were significant, so a reduced model was not possible. For each of the three models, I calculated adjusted R^2 to demonstrate explanatory power, p-values to indicate significance, and an F statistic to express goodness of fit.

Finally, still using "public influence" as a response variable, I applied a nonparametric two-tailed Kruskal-Wallis test for difference of means to look for a difference based on cultural theory worldview. I also used a series of pairwise Kruskal-Wallis tests to see if respondents who held any particular wildfire frame were more or less likely than others to indicate consideration of public input in regional wildfire risk mitigation. I used pairwise tests for the wildfire frames because each individual can hold multiple frames, whereas participants could only be assigned one cultural theory worldview. I used a nonparametric test because the data were ordinal. In the pairwise tests, I used Bonferroni-corrected Alpha levels for significance tests to reduce the risk of type I error. All significance tests were applied at the 90% (*), 95% (**), and 99% (***) confidence

levels. Statistical analyses were conducted in the R statistical computing environment, using the packages "leaps," "car," and "psych."

3. RESULTS

3.1. Regression

Table 5 describes three models that use measures of culture to explain managers' attitudes about the influence of public input in wildfire management. Model 1, which used measures of the four worldviews derived from cultural theory as predictor variables, was not significant ($p = 0.577$) and did not explain any variance in the response variable (adjusted $R^2 < 0.000$). On the other hand, Model 2, which used the wildfire frames as predictor variables, was significant ($p = 0.012$) and explained 21.0% of the variance (adjusted $R^2 = 0.210$). Further, Model 3 (the reduced version of Model 2) used four of the six wildfire frames (*equity*, *climate*, *wilderness*, and *hazard*) to explain 24.2% of the variance (adjusted $R^2 = 0.242$), with a significant p-value of 0.002. These four frames also held the most influence in Model 2, as demonstrated by the largest coefficients. *Life*, *equity*, and *hazard* each had a positive effect on the response variable "public influence," while *restoration*, *climate*, and *wilderness* each had a negative effect.

Table 5: coefficients of three linear models that use elements of culture as predictor variables and "public influence" as a response variable. Significance tests were applied at the 90% (*), 95% (**), and 99% (***) confidence levels.

	Variables	Model 1 (cultural theory)	Model 2 (wildfire frames)	Model 3 (wildfire frames– reduced)
Cultural theory	*Individualist*	0.278	–	–
	Hierarchist	0.242	–	–
	Egalitarian	0.163	–	–
	Fatalist	0.275	–	–
Wildfire frames	*Restoration*	–	-0.066	–
	Life	–	0.021	–
	Equity	–	0.198	0.209*
	Climate	–	-0.268**	-0.266**
	Wilderness	–	-0.192	-0.202*
	Hazard	–	0.449**	0.454***
Model adjusted R^2:		**<0.000**	**0.210**	**0.242**
Model p-value:		**0.577**	**0.012****	**0.002*****
Model F-statistic:		**0.730**	**2.62**	**4.91**

3.2. Difference of means tests

A Kruskal-Wallis test for difference of means found no difference in wildfire managers' responses to "public input" based on cultural theory worldview. When considering the wildfire frames, though, a series of pairwise Kruskall-Wallis tests showed that managers

who frame wildfire as a hazard are more inclined to incorporate input from the public into their wildfire risk mitigation projects ($p = 0.0061^{**}$).

4. DISCUSSION

4.1. Assessing operational measures of culture

The development and empirical confirmation of the six wildfire frames is novel and notable. As confirmed by factor analysis, these wildfire frames indicate that there are at least six distinct ways that some people see and respond to wildfire risk. These six frames should not be regarded as representing an exhaustive list of the ways that people understand wildfire risk, but rather an indicator that the idea of "framing" is one way to represent culture in natural resource management. Respondents held an average of 2.75 frames, with several holding as many as five frames. This provides empirical evidence to Thompson et al. (1990) and Grendstad et al. (1995)'s ideas of multiple self allowing individuals to hold different ideas about an issue, likely employing each frame in different settings. These frames are specific to wildfire risk, and are not intended to be generalizable to other issues in natural resource management. For other topics, qualitative research should be leveraged to identify potential frames that are relevant to the issue of interest.

Wildfire frames are just one way to represent culture, and cultural theory worldviews are another valid representation of culture in some contexts. In this study, though, multiple regression and difference of means tests found no influence of cultural theory worldviews

over wildfire managers' likelihood to incorporate public input into wildfire risk mitigation projects. This finding echoes the empirical findings of Hoogstra-Klein et al. (2012) that the cultural theory framework is not the right tool for understanding the connection between culture and participatory processes in resource management. On the other hand, managers' reported likelihood to include public input in their management decisions was apparently shaped by the ways that they frame wildfire risk. Multiple regression found that four of the wildfire frames explained nearly 25% of the variance in the "public input" variable, and difference of means tests illustrated that managers holding the *hazard* frame were significantly more likely to include public input in their decisions.

The influence of wildfire frames on managers' attitudes about the importance of public input is notable for two reasons. First, it provides novel empirical evidence that underlying cultural contexts do impact individuals' natural resource management priorities. While many scholars have theorized about the potential relationship, empirical evidence of that relationship has been severely lacking. Second, these findings begin to point to useful ways to capture the idea of culture as it relates to management decisions. The wildfire frames were designed around four principles: 1) culture should be assessed at the individual scale, not by organization; 2) culture should be considered as it pertains to specific issues, rather than as a broad and totally generalizable concept; 3) measures of culture should include both physical and social aspects of the issue at hand; and 4) measures of culture should allow for multiple understandings of complex issues. To

continue to search for useful operational measures of culture, future studies should include some, but not necessarily all, of these principles and should test a variety of natural resource management issues beyond wildfire risk. The second principle, especially, might be met with some skepticism because of the broad reach that some aspects of culture have into most of our lives. Nisbett and Miyamoto (2005), for instance, discussed how broad cultural differences between Easterners and Westerners lead to completely different perceptions of the world that have cascading impacts on daily life. From an operational standpoint, though, the best level at which to assess culture is ambiguous and may depend on the context of the study. In this study of public input in management decisions, the generalizable measures of culture did not impact this aspect of management (despite the measures being empirically-validated and successfully applied to individual managers), while the measures of culture that were specific to wildfire risk did. This may be related to an idea expressed by Ingold (1994) that there are no universally distinct cultural groups because the individuals who comprise those groups generally do not align on every imaginable issue.

4.2. Divergent visions of a landscape shape wildfire managers' priorities

Regarding the specific impacts of culture on wildfire managers' inclination to consider public input when planning wildfire risk mitigation projects, four of the wildfire frames demonstrated the most influence. While two of the frames (*restoration* and *life*) did not demonstrate significant influence over "public input," that certainly does not undermine the validity of the two frames. Rather, those two frames might have greater influence

over other aspects of wildfire risk mitigation, while the other four frames maintain the most influence over the issue of public inclusion. Results of the regression reveal that viewing wildfire as a hazard or as an issue of equity appears to make managers more likely to rely on the public for guidance, while understanding wildfire as a climate or wilderness issue makes them less likely to be concerned with the public's preferences. These results do not explain why this is the case. Qualitative research would be best for understanding why, but a few potential reasons are apparent.

The issue of equity may be the most obvious: decades of expert-driven resource management imposed negative environmental consequences on some groups of people more than others (Mohai et al. 2009). To avoid repeating this, managers who are concerned with the equity issues tied to wildfire risk may be more likely to consider the perspectives of community members who bear the most adverse consequences of wildfire. That could be compared to managers who frame wildfire risk as a climate issue, who might be more focused on utilizing scientific tools like future climate projections, rather than prioritizing the short-term desires of the community. Meanwhile, managers who see wildfire as a hazard to human development might be most concerned with protecting human values at risk, and nobody knows more about those values than community members themselves. Conversely, managers who frame wildfire risk as a wilderness issue probably understand adverse impacts of wildfire as an inherent risk of life in wildfire-prone landscapes, and might be less inclined to set aside ecological priorities to protect the livelihoods of people who voluntarily live in at-risk areas.

The division between managers who frame wildfire as an issue of climate or wilderness and those who frame wildfire as an issue of equity or hazard might be related to broader dilemmas in natural resource management. Salomon et al. (2018) explained that despite being intertwined, objectives of ecological sustainability and social justice have not typically been treated as equally important goals in environmental management. They attributed these discrepancies in part to two divergent ways of thinking: *scientific reductionism*, or the breaking down of an issue into distinct components to prioritize and address in isolation, and *systems thinking*, or a holistic understanding of issues and their implications. Systems thinking often emphasizes the interconnected nature of humans and ecosystems. Systems thinking might lead Central Oregon's wildfire managers to include social goals (like those related to equity and hazards to human development) in wildfire management, while scientific reductionism might push wildfire managers to prioritize ecological goals (like those related to climate and wilderness) based on the nature of their responsibilities as natural resource managers. While considering diverse perspectives of natural resource issues, it is valuable to remember Pendergraft (1998)'s sentiment that everybody wants to manage for the "best" outcome, but specific goals vary not because people are making priority decisions based on identical visions of the issue, but instead because differing cultural contexts lead people to see completely different landscapes when they look at the world.

4.3. Culture shapes collaborative processes

A primary goal of this research was to better understand the role of culture in

collaborative governance theory. The integrative collaborative governance framework presented by Emerson et al. (2012) includes "socioeconomic and cultural health and diversity" as part of the general *system context* (which also includes topics like "resource conditions," "prior failure to address issues," "political dynamics," and others), but diminishing the role of culture simply to one of many factors that impact overall function of the collaborative governance regime does not adequately reflect the influence that cultural perspectives maintain over participatory processes. The empirical results presented in this study suggest a connection between cultural perspectives and practices of inclusion in the collaborative process. Within Emerson's framework, that connection is more likely tied to the *principled engagement* collaborative dynamic, which represents the norms surrounding stakeholders' engagement with each-other. In Emerson's words, those norms are "balanced by representation of all relevant and significant different interests," and are "informed by the perspectives and knowledge of all participants" (Emerson et al. 2012, p. 11). It is these very perspectives that, in part, influence who and what natural resource managers consider to be a "significant interest," who they choose to invite to the collaborative table, and how much consideration is given to the priorities of some stakeholders. Divergent perspectives about the very nature of an issue, rooted in and represented by culture, could function as another element in the *principled engagement* dynamic. Alternatively, it might serve as the nexus between the *system context* and the *principled engagement* dynamic, functioning as the mechanism through which multiple contexts of the issue at hand shape the norms of stakeholder engagement. The difference between these two possible functions might be semantic, but either would

more appropriately represent the apparent connection between the cultural contexts of individual natural resource managers and the norms of inclusion and representation that they determine.

4.4. Limitations

The purpose of this study was to analyze regional wildfire managers' cultures and the connection between those cultures and managers' attitudes about public input in collaborative wildfire risk mitigation. Thus, the concepts presented here should be only cautiously generalized to broader societal practices, and confidence in their generalization even to natural resource management more broadly should be contingent upon further empirical studies in areas of management beyond wildfire risk. Also, with a sample composed entirely of wildfire managers in one region, ideological diversity among research participants was limited. For example, considering the cultural theory worldviews: this sample included 39 egalitarians compared to only two fatalists. This skew is not incidental, as similar skews have been documented in other surveys of natural resource managers (Calanni et al. 2015; Monroe et al. 2014; Armstrong 2017). Similarly, considering the wildfire frames: 46 managers framed wildfire as a restoration issue, while only 6 framed it as a hazard. A more ideologically diverse sample might yield more robust results, but natural resource managers are the subjects of interest here and, as a group, they tend to be less ideologically diverse than broader society (Prell et al. 2009). Despite the relative homogeneity of participants, the adjusted R^2 and p-values of the regression models that included wildfire frames indicate confidence in the findings.

5. CONCLUSIONS

This study presents empirical evidence that culture, representing different ways of looking at the world, influences regional wildfire managers' attitudes about the role of public input in wildfire management decisions. To demonstrate that link, I developed and empirically validated a novel framework that considers different cultural lenses for framing wildfire risk that are rooted in conceptions of nature and society. The principles that guided the development of this framework emphasized assessment at the individual level, operationalizing culture as it pertains to a specific issue, including physical and social aspects of the issue under consideration, and allowing for multiple cultural positions to be assigned to each individual. Measures of culture using this method explained nearly 25% of the variance in wildfire managers' self-reported propensity to include public input in wildfire risk mitigation efforts, compared to 0% of the variance explained by measures of culture derived from a commonly used existing framework.

The novel framework provided insight into why some wildfire managers are more or less likely to be responsive to public input: managers who framed wildfire risk as an issue of equity or as a hazard were more likely to consider public input in risk mitigation, while those who framed wildfire risk as a climate or wilderness issue were more reluctant to allow public input to influence their management decisions. I contextualized these results as they pertain to collaborative governance theory, suggesting a couple of potential roles that culture might play in collaborative governance regimes, which were primarily related to stakeholder legitimacy and inclusion. Future research should 1) further empirically

validate this framework for operationalizing culture in areas of natural resource management beyond wildfire risk mitigation, and 2) seek to better understand why exactly managers who view an issue through one particular frame are led to make decisions differently than managers who do not view the issue through that frame.

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APPENDIX

Supplemental file: *Co-Managing Wildfire Risk in Central Oregon: Survey results of the wildfire management network in Central Oregon (Phase II)*. 12.5 MB PDF file.

CONCLUSIONS

The Northwest Forest Plan, implemented by the US Forest Service in the 1990s, identified a goal of promoting agency-citizen collaboration in forest management, but initial assessment found that goal to be unfulfilled (Charnley 2006). The findings presented in Paper I illustrate how limited amounts of public input are currently included in wildfire adaptations in Central Oregon. Federal law (primarily the National Environmental Policy Act of 1970) provides a specific mandate for including public feedback in projects slated for implementation on federal lands, and wildfire managers in Central Oregon adhere to those guidelines. The technocratic processes for submitting feedback, though, has been identified as a barrier to effective inclusion of community input (Frentz et al. 2000). In Central Oregon, feedback submitted during the NEPA process may be included, but much of the feedback is excluded from projects typically because members of the public do not understand the already determined goals and scope of the project. Managers expressed a lack of concern about omitting feedback like this because community concerns typically fade after implementation.

The more impactful way that public input gets incorporated into wildfire risk projects is through organizations' careful cultivation of their reputations. Managers tend to be concerned with their reputations because they need to maintain social license, a general acceptance of their activities by the community. Without social license, projects are likely to stall due to litigation. Managers are willing to make significant sacrifices to preserve social license, like delaying implementation of time-sensitive projects to avoid disrupting

community events. This appears to be the most influential way that the Central Oregon public shapes wildfire adaptations, though it provides little opportunity for adaptations to be directly guided by the community itself.

This framework for integrating public input into projects allows wildfire managers a large amount of flexibility in how they choose to include public feedback. Some managers are more accepting of public input than others, and I found that those attitudes are shaped by cultural perceptions of wildfire risk. A plethora of literature has suggested that culture impacts attitudes about natural resource management (Wilson 1997; Billgren and Holmén 2008; Hoogstra-Klein et al. 2012; Tansey and O'Riordan 1999), and the findings presented in Paper II illustrate that different conceptions of wildfire risk lead managers to different ideas about the role of public input in regional wildfire risk mitigation. These conceptions are not adequately represented by generalizable views about risk commonly applied in natural resource management using cultural theory. Instead, I proposed and empirically validated the use of at least six different cultural lenses through which individuals frame wildfire risk. Rooted in culture, these wildfire frames demonstrated significant influence over managers' attitudes toward public inclusion in wildfire risk management, with managers being more likely to consider public input if they frame wildfire risk as a hazard and as an equity issue, while framing wildfire risk as a wilderness and climate issue makes managers less likely to believe in the importance of public input. This methodology of leveraging "frames" that represent distinct views on specific issues may be useful in studying cultural influence on natural resource

management. Future research should apply a similar concept of frames to other issues in natural resource management or other collaborative management to empirically validate the framework's utility in fields beyond community adaptations to wildfire risk.

As resources targeted at community adaptations to wildfire grow, policymakers, managers, and communities need to consider vital questions about who should be included in designing wildfire-adapted communities and what the role of each stakeholder should be. Currently, management agencies and other organizations plan wildfire adaptation projects by leveraging the best available science, but science is not objective and is inherently reflective of values (Sherry et al. 2019; Johnson et al. 2009). Excluding the public from key decisions about what types of projects are desirable, where to plan them, and how to implement them dramatically decreases the likelihood that those projects will be effective and reflective of the values present in the community (Talley et al. 2016; Knapp et al. 2014; Maak 2007; Freeman 1983; Johnson et al. 2012). Managers' continuous application of the concept of "social license" reinforces a structure where managers design projects based on their values and make some concessions based on pressure from the community. An approach to cultivating wildfire-adapted communities that is more reflective of the community's values would involve inclusion of the public in the initial design of wildfire risk management projects. By applying the integrative collaborative governance framework synthesized by Emerson et al. (2012), I conclude that wildfire managers in Central Oregon are leaving latent adaptive capacity untapped by

not deliberately including the public in the early stages of designing wildfire adaptation projects.

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