FireNet Adaptation through Collaboration

Co-Managing Wildfire Risk in Central Oregon

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Survey Results of the
Wildfire Risk Management Network
in Central Oregon

Summer 2021

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1. Introduction

Central Oregon is a national hotspot of wildfire risk due to the potential for transmission of wildfire from federal lands to communities and infrastructure adjacent to those federal lands. Recent analyses funded by the USDA Forest Service (USFS) identified National Forests in Central Oregon as one of two dozen core firesheds across the western United States (Figure 1). Collectively these 24 hotspots account for nearly 80% of the fire predicted to be transmitted between USFS lands and nearby communities in the western US (USDA Forest Service, 2018[1]). Following large wildfires over the past two decades, managers, policymakers, and practitioners in Oregon have begun work to implement the resilient landscapes, fire-adapted communities, and safe and effective response goals of the National Cohesive Wildland Fire Management Strategy (hereafter, the Cohesive Strategy; USDA-USDOI, 2014[2]). To do so, the Cohesive Strategy calls for the following: (1) Strategically alignment of goals, programs, and actions across jurisdictions; (2) Collaborative engagement on issues including governance, sharing of information and resources, communications, and monitoring and accountability; (3) Programmatic alignment of individual agency/organization objectives with Cohesive Strategy goals.
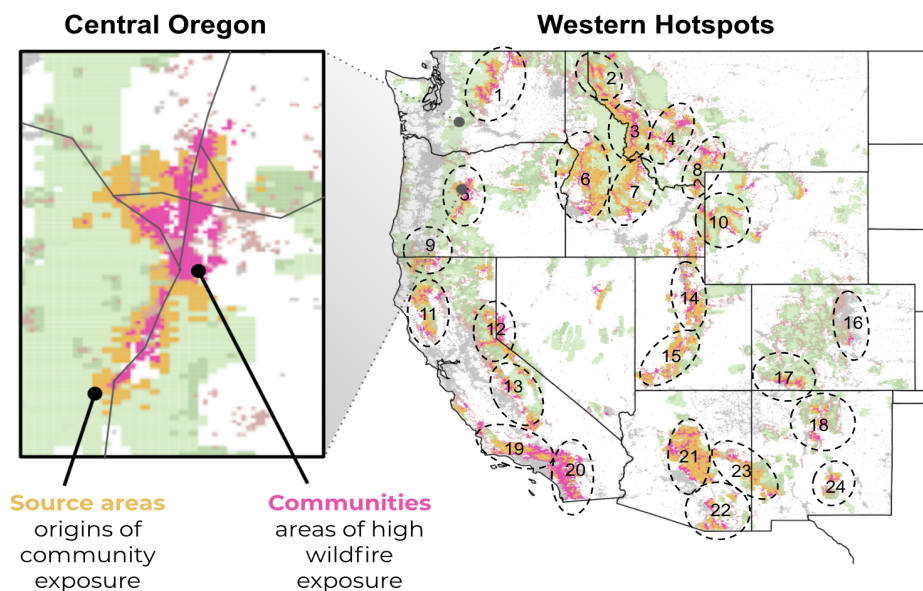
Figure 1. *Hotspots of wildfire risk contribute 80% of the predicted fire to communities in the Western US. Central Oregon is one of two dozen hotspots. Adapted from Evers et al. (2018)[3].*

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[1] USDA Forest Service. 2018. Towards shared stewardship across landscapes: An outcome-based investment strategy. USDA Forest Service Report FS-118 (August 2018).

[2] USDA and USDOI. 2014. The national strategy: The final phase in the development of the National Cohesive Wildland Fire Management Strategy.

[3] Evers, C.R., M. Nielsen-Pincus, and D.B. Jacobs. Wildfire management networks: Hotspots of innovation? Presented on June 19, 2018; International Symposium on Society and Resource Management. Snowbird, UT.

As part of the NSF-funded research grant entitled Developing Adaptive Capacity in Wildfire-Prone Regions[4] (CNH2-L #1922866), Portland State University (PSU) conducted a survey of the wildfire risk management network working in Central Oregon alongside a series of workshops with stakeholders in the region. This report describes the survey results and is informed by workshop conversations. The survey was designed to describe the diversity of the wildfire risk managers and organizations operating in the Central Oregon hotspot, including their roles in wildfire risk management and who they work with. This report provides an overview of the region, the research approach, and results from the survey. Implications, recommendations, and conclusions are discussed at the end of the report.

This research builds from the concept of wildfire risk governance, which describes the rules, norms, and processes that structure individual and collective efforts to reduce wildfire risk. Our work specifically examines the network of individuals and organizations engaged in wildfire risk governance with the intention of documenting the spectrum of actors, roles, processes, and scales upon which wildfire management is distributed -- and the basis on which the capacity to adapt lies. The concept of networks is increasingly used by wildfire leadership, policy-makers, and researchers to describe how risk is managed and capacity can be grown. The National Cohesive Strategy, for instance, strongly emphasizes the need for increased strategic, collaborative, and programmatic integration across federal, state, and local actors involved in wildfire risk management. Throughout this report, we use terms such as wildfire governance, wildfire risk management systems, and wildfire risk management networks somewhat interchangeably.

1.1. About Central Oregon

Central Oregon flanks the east slopes of Oregon's Cascade Mountains, ranging nearly 170 miles north to south from Mt Jefferson and the Confederated Tribes of the Warm Springs Reservation of Oregon (to the north) to the upper reaches of the Deschutes Basin in northern Klamath County (to the south). In the span of approximately 70 miles from west to east, the region transitions from subalpine forests near the crest of the Cascades through lodgepole pine and ponderosa pine forests to the high desert plateau in the east. Fire ecology in the region varies from infrequent, high-intensity fires near the Cascade crest to more frequent fire regimes in warmer and drier forests that vary in intensity as a function of vegetation and past management.

The region has long been one of Oregon's fastest-growing population centers as people flock to Central Oregon for quality of life, the dry sunny climate, and access to amenities. Deschutes County, for example, was Oregon's fastest-growing county between 2010 and 2020, with the population during the timespan growing more than 25%. Over half of that growth centered in Bend, although the population in other regional cities grew dramatically as well. Sisters, Oregon, for instance, saw a 50% population growth between the decennial censuses.

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[4] https://firenet.uoregon.edu
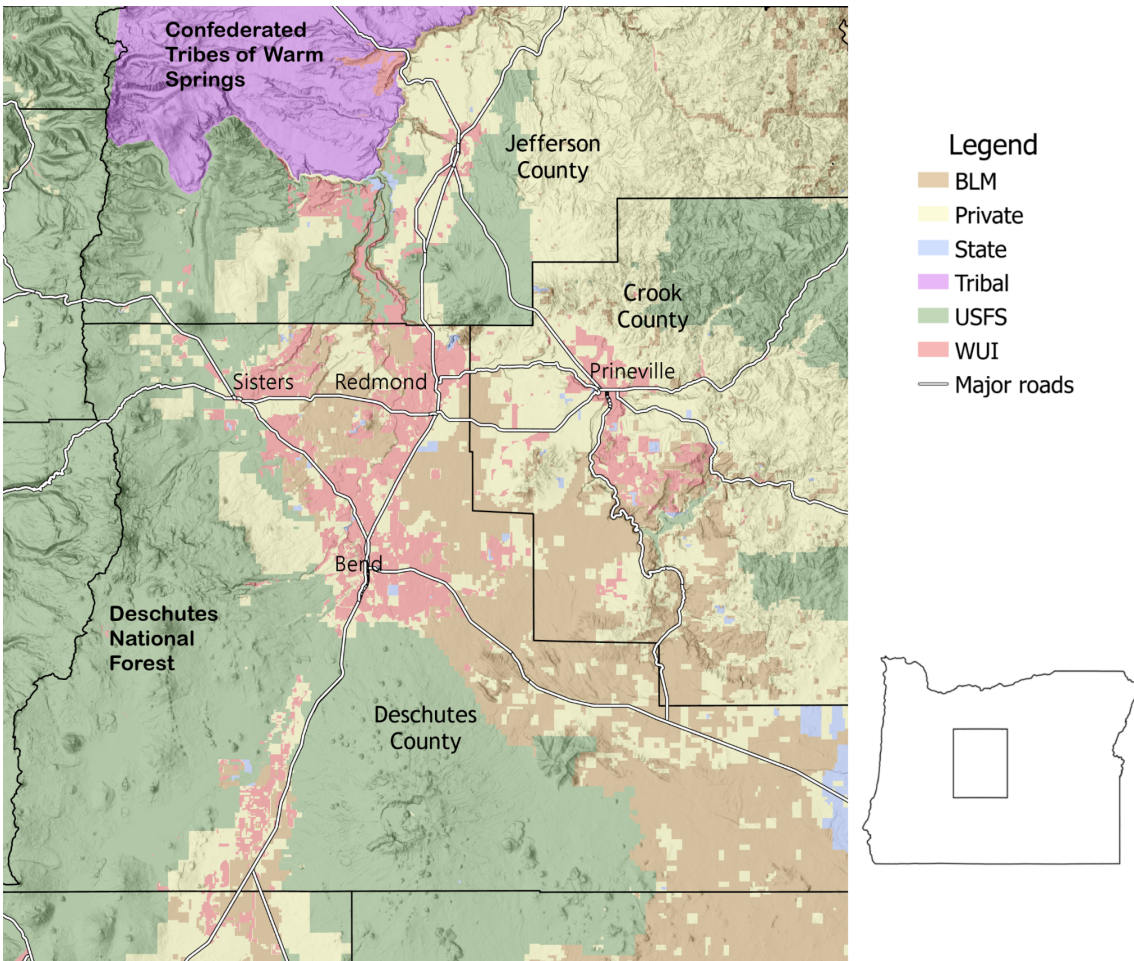
Figure 2. *The study area in Central Oregon includes lands in Jefferson, Crook, and Deschutes counties. The Warm Springs reservation lies to the north, the Deschutes National Forest to the west and south, and the Ochoco National Forest to the east.*

Although the proximity to natural and recreational resources in Central Oregon is a substantial draw, growth has also increased wildfire risk as homes, forests, grasslands, and other infrastructure become intermixed within the wildland urban interface. Efforts to reduce wildfire risk range from mechanical fuels treatments and prescribed fire on private and public lands, to locally-led community organizations aiming to develop partnerships to maximize community resilience, to new approaches to housing development that address fire risk management in housing standards and neighborhood layout. Organizations like Project Wildfire, an outgrowth of Deschutes County, work to develop and increase the capacity of a network of partners and practitioners in the region to address wildfire risks by facilitating the development of community wildfire protection plans, securing grants, sharing resources, and coordinating among a wide array of actors. These efforts engage local community members and increase the capacity of a wildfire risk management network. Since 2003, no homes have been lost to wildfire in Central Oregon, and Project

Wildfire partners and others celebrate this success while continuing efforts to reinforce efforts towards creating and sustaining fire-adapted communities.

2. Methods

We surveyed professionals and stakeholders in Central Oregon whose work is directed at or affected by wildfire in the region with the intention of identifying and describing the spectrum of stakeholders and activities related to wildfire risk prior, during, and following wildfire. In addition, this work attempts to "stitch together" these elements into a "social map" by showing who is most closely connected to who and which individuals or organizations are playing important bridge district groups of stakeholders or activities. This approach is based on similar research conducted in North Central Washington and Northern Utah, with the overall goal of assembling and comparing wildfire risk management systems in different regional wildfire hotspots.

2.1. Sampling

The survey began in April 2021 with help from the FireNet Stakeholder Advisory Council, which was convened to provide insight and guidance on the larger NSF-funded research grant. The questionnaire asked respondents to list the names and affiliations of up to 20 individuals that the participant had worked with on wildfire risk management over the past 5 years. These individuals were then recruited to participate in the survey in a subsequent round of recruitment. This snowball sampling continued for a total of ten rounds of recruitment and ended on July 31, 2021. The rate of recruitment peaks at round 3 and tapered as more and more of those identified as working partners had already been identified in previous rounds and recruited to the survey. This pattern suggested that the sampling had reached a point of saturation and that most individuals within the management system had been identified.

2.2. Questionnaire

The questionnaire contained three sections. The first section, *Your work on Wildfire*, included questions inquiring about the respondents, their position, the organization they affiliate with, and the roles the actor plays in wildfire risk management. The second section, *Mapping Wildfire Vulnerability and Resilience,* consisted of an online mapping exercise in which participants identified locations where they have recently worked on wildfire. The final section, *Who You Work with on Wildfire*, included questions that inquired about respondent working relationships, including who they work with, who influences their work on wildfire risk management, how often they interact with their nominated colleagues, and the types of work respondents do with each of their nominees.

2.3. Analysis

Results from the questionnaire are presented in a series of tables, quotes, maps, and diagrams. For the most part, responses to each survey question are summarized as tables, which report the combined percentages from all respondents, followed by the specific

percentages of affiliation groups commonly referenced in wildfire-related documents or our interactions with stakeholders in the region:

1) Federal (primary USFS & BLM)
2) State (primarily Oregon Department of Forestry)
3) Non-Governmental Organizations
4) Local Government (e.g., municipal and county)
5) Fire Departments
6) Private Businesses
7) Tribal Government
8) Universities

In this report, we lump the final three groups together in an "*other*" category, given the smaller number of individuals that identified for the survey from each of these affiliations. We recognize that this "*other*" group is difficult to generalize, and have chosen not to write about the findings of the "*other*" group unless there is something uniquely striking about the results. Nonetheless, we emphasize the presence of organizations and individuals from the private sector, tribal governments, and universities within the management system, and acknowledge potential under-representation in the survey results.

To identify notable differences among specific affiliation groups, percentages for individual groups are highlighted if they were statistically higher or lower than the combined percentages for all respondents. These highlights thus provide some insight into how different groups in the wildfire management network of Central Oregon differ from one another. Specially, we highlight differences between the observed and expected responses greater than 1 or less than -1 based on the following formula: (observed – expected) / √[expected · (1 – row total proportion) · (1- column total proportion)].

Survey responses from the mapping exercise were compared to the land ownership in which they fell in addition to their distance from the wildland-urban interface. In order to balance the weight of the information provided by different respondents, we randomly selected 10 points of all those provided for those that marked more than 10 points of either vulnerability or resilience.

The management network was constructed using working relationships reported by the survey respondents. Doing so involved creating a complete log of who reported working with who and in what capacity. Given that most people reported 5 or more of these working relationships, this log was much bigger than the number of survey responses alone. Using this relationship log, we built social networks using the "ball-and-string" network graphs where each ball (or "node") represents an individual within the Central Oregon wildfire management system and each string (or "edge") represents a working connection between individuals.

3. Results

The survey identified a total of 210 individual practitioners in the Central Oregon wildfire risk management system. Of those identified, 171 individuals were contacted to participate in the survey. Of those not contacted, typically it was because we were unable to locate contact information. Of those contacted, 116 (57%) responded to the survey. Of those that responded, 80% identified vulnerable and resilient locations in the mapping portion of the survey and 80% reported 1 or more of their working relationships within the region. Survey results were primarily drawn from the 116 respondents, while detailed network data were derived from the 96 individuals that reported their more common working relationships.

Table 1. *Survey numbers and response rates.*

Identified		Contacted		Responded		Networked
210	→	171	→	116	→	96
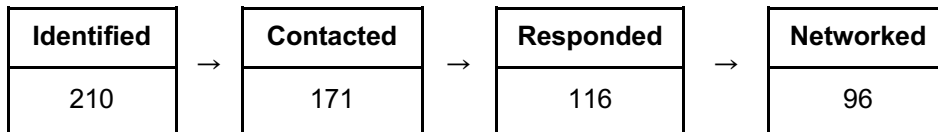
We asked participants to identify the agency, organization, or firm they were affiliated with within their work on wildfire risk management. Affiliations included federal, state, local government, non-governmental, fire departments, and other organizations (Table 2). We grouped all Federal agencies together, which made up 30% of all participants. Respondents affiliated with state and local agencies comprised 14% and 17% of all respondents respectively. Those affiliated with NGOs made up 14% of respondents, and those affiliated with fire organizations (namely local fire departments) made up another 13% of respondents. Other affiliations included private companies (8%), tribes (3%), and universities (2%). The rate of response was roughly equal among the primary affiliation groups, suggesting that the results discussed in this report are representative of the larger region, including those not surveyed.

Table 2. *Survey participant affiliations (n=210)*

Group	Subgroups	Group	Subgroups
Federal (62, 30%) (45% responded)	USFS (54)	Local (35, 17%) (49% responded)	County (28)
	BLM (6)		City (8)
	NRCS (2)		Local Coalition (3)
			Individual (1)
State (29, 14%) (52% responded)	ODF (20)		Conservation District (1)
	OSFM (3)		
	DPSST (2)	NGO (29, 14%) (62% responded)	County (28)
	DEQ (1)		Regional (8)
	ODFW (1)		National (4)
	ODSL (1)		State (4)
	OEM (1)		TNC (4)
			Local (3)

Other (28, 13%)   Private (17)
(75% responded)
                         Tribal (6)   Fire (27, 13%)   Fire departments (27)
                                                       (59% responded)
                         University (5)

3.1.The types of work involved in wildfire risk management

The first section asked respondents about their role and the relevance of wildfire in their work. Each question is listed in *italics* and the results are reported in text and tables. The tables in this report show the percentage breakdown of responses across all respondents. In many cases, the percentages of individual organizational groups differed substantially from the overall pattern. Percentages for individual groups that were statistically higher than the combined percentage are highlighted in green; percentages statistically lower are highlighted in red (see the methods for details).

3.1.1. How focused is your work on wildfire risk management?

Wildfire risk management was one of a number of professional responsibilities for a majority of respondents (Table 3). Across all affiliations, nearly 91% of respondents indicated that wildfire risk management was either the main focus or one of a number of their position's main issues. NGOs were more likely to report fire as the main focus of their work, while local government and fire districts were less likely to report wildfire as their main focus. One individual affiliated with other organizations indicated that, despite being nominated, wildfire was not directly related to their work.

Table 3. *Focus on wildfire in the context of other professional responsibilities (n = 115). Rows add to 100%. Colored cells are significantly higher (green) or lower (red) than the combined percentage.*

Focus	All	Federal	State	NGO	Local	Fire	Other	Count
Main focus	28%	29%	33%	50%	18%	12%	24%	32
One of several foci	63%	68%	60%	50%	65%	69%	67%	73
Pertinent but secondary	8%	4%	7%	0%	18%	19%	5%	9
Not related	1%	0%	0%	0%	0%	0%	5%	1
	100%	28	15	18	17	16	21	115

3.1.2. Years of experience in wildfire risk management?

Most respondents reported greater than 10 years of experience in wildfire risk management. Only 10% had fewer than 1 year of experience, and 27% had fewer than 5 years of experience. Just one individual reported more than 20 years of experience. Wildfire experience was greatest among federal agencies and local fire departments, and was least in local government.

Table 4. *Years of experience in wildfire risk management. Rows add to 100%. Colored cells are significantly higher (green) or lower (red) than the combined percentage.*

Experience	All	Federal	State	NGO	Local	Fire	Other	Count
< 1 year	10%	7%	0%	5%	35%	6%	10%	12
1 - 5 years	17%	7%	33%	32%	18%	6%	15%	20
6 - 10 years	22%	25%	13%	32%	12%	12%	30%	25
11 - 20 years	50%	61%	47%	32%	35%	75%	45%	57
> 20 years	1%	0%	7%	0%	0%	0%	0%	1
	100%	28	15	19	17	16	20	115

3.1.3. What roles are involved in managing wildfire risk?

Respondents indicated that their work involved a variety of aspects related to wildfire risk management, ranging from convening diverse stakeholders, to emergency response, and many respondents reporting working in multiple roles. The least common wildfire roles reported were planning fire adapted communities (40%) and assessing fire risk and hazard conditions (53%), while coordinating across jurisdictions or interests (78%), and providing leadership or authority to address fire risk (66%) were the most common. State respondents were significantly more likely to participate in responding to emergencies when called, while NGO respondents were significantly more likely to participate in convening diverse stakeholders (Table 5).

Table 5. *Roles played in managing wildfire risk. Rows do not add to 100. Colored cells are significantly higher (green) or lower (red) than the combined percentage.*

Role	All	Federal	State	NGO	Local	Fire	Other	Count
Coordinating	78%	82%	87%	79%	82%	81%	57%	90
Authorizing	66%	75%	67%	68%	47%	81%	52%	76
Convening	61%	46%	53%	84%	76%	56%	57%	71
Responding	60%	79%	73%	21%	59%	81%	48%	70
Engaging	59%	46%	40%	63%	53%	88%	71%	69
Implementing	56%	79%	27%	63%	47%	50%	52%	65
Assessing	53%	61%	40%	26%	65%	75%	52%	62
Planning	40%	21%	27%	58%	59%	38%	43%	46

Respondents wrote in their own words a brief description of their primary role with respect to wildfire. A sample of quotes is used below to illustrate the range of responses in each theme. Many quotes have been modified for consistency, clarity, and anonymity.

Planning fire-adapted communities: Work that requires working closely with communities to mitigate wildfire risk, including the Community Wildfire Protection Plans, fuel reduction, and increased community awareness and engagement in risk mitigation and wildfire preparedness activities. Examples include:

- "I develop Natural Hazard Mitigation Plans for communities at risk to wildfire impacts."

- "I manage and direct planning and implementation of fuels treatments and wildfire response over a highly populated and high-frequency fire-adapted and -prone geographic area."

- "I work on multiple scales, focused on working with private landowners to prepare for and recover from wildfires, but also with local, state and federal agencies on planning and implementing watershed-scale cross-boundary projects."

Coordinating across jurisdictions or interests: Work with individuals from different jurisdictions or interests to coordinate and accelerate wildfire mitigation activities across scales and land ownerships. As such this was easily the most commonly cited role.

- "I work locally with a wide range of partners to understand what it means to live in and around fire-dependent, fire-prone forest systems"

- "I assist with coordinating emergency response in Central Oregon and throughout the state. Working with local, state, and federal partners to address wildfire risk throughout the western US."

- "I coordinate information for the public and media to communicate wildfire risk and conditions as well as provide information for current wildfires."

Providing leadership or authority to address fire risk: Supervisory or administrative work involving a large number of people or area of land, often associated with a government agency, and typically worked at a management level.

- "I supervise and manage both detection of wildfires and prevention within our zone and broader. I regularly manage fires in the area and nationally, usually at the higher complexity levels and in interagency operations."

- "I lead wildfire legislation for the Oregon Fire Chiefs Association during the 2021 legislative session and represent Oregon on the Western Fire Chiefs Wildfire Initiative."

- "I supervise the federal forest restoration program for all of Central Oregon. I also participate on the steering committee for the Central Oregon Cohesive Strategy."

Engaging with landowners or homeowners about fire: Work that involves evaluating landowners' wildfire risk and liability, and providing outreach to residents around the WUI, informing them of their risk and actions to reduce it.

- "I provide education and outreach to Central Oregon residents around the need for fuels reduction treatments, and work to increase community support and social license, with the goal of increasing the pace and scale of restoration work."

- "I work with other members of the community to assure that treatment and evacuation plans are in place for the 1353 homes located within the ponderosa forested WUI in our area."

- "I inspect the individual risks of individual policyholders to determine the extent of the wildfire exposure. I then advise the policyholder how to mitigate the wildfire exposure before there is a wildfire event."

Implementing projects to reduce fire risk: Work that tends to be on-the-ground and involves directing, managing, or performing risk reduction work, including hazardous fuels reduction tasks, thinning and prescribed fires.

- "I perform ladder fuel reduction and tree thinning on commons and conduct private property inspections and enforce the community LFR Plan."

- "I provide program oversight for hazardous fuels reduction planning and implementation."

- "I plan and implement fuels treatments intended to reduce wildfire risk."

Assessing fire risk and hazard conditions: Work related to assessing insurance liability, assessing hazardous fuels reduction projects, assessing risk from smoke, and assessing community risk from wildfires. Individuals that cited this role worked for a variety of organizations, including real estate companies, insurance companies, NGOs, and government agencies.

- "I work for a real estate development company and we are engaged in building fire resilient neighborhoods. I have coordinated Fire Risk Assessments for existing neighborhoods and worked to create the first Firewise community from the ground up. I work closely with a fire consultant on our land use, design guidelines, and CCRs for new neighborhoods."

- "My responsibility is to assess the risk of the community, communicate that risk to the elected board of directors, seek their direction on the level of risk tolerance they wish to assume, and manage the risk to their standard given the district's budget."

- "I primarily work with stakeholders to assess wildfire smoke conditions and provide health messaging on how the community can protect themselves from smoke."

- "I assess and develop hazardous fuels reduction projects in collaboration with community and agency partners."

Responding to emergencies when called: Work in emergency response, with structural and/or wildland fires typically. Many times this was not the respondents' primary duty, but an auxiliary duty they were expected to be ready for.

- "As a firefighter and chief, I manage our wildland fire response team and coordinate a response team in state and county mobilizations."

- "I respond to emergencies in my role as a public information officer as part of an incident management team."

- "I am a burn boss for prescribed fire within the district during burn season and I respond to wildfire events locally/nationwide during the fire season in various suppression-related capacities."

3.1.4. Scale of work addressing wildfire risk

Risk management spans multiple scales and is highly dependent on the job. In this question, respondents were asked to select the geographic scale that best represents the majority of their work, such as a single community (neighborhood, city, etc.), a small number of communities, a specific jurisdiction (e.g., a fire protection district), a regional focus comprising multiple jurisdictions or communities, or that the majority of their work is focused elsewhere. Work in multiple jurisdictions was the most common response, and this was especially pronounced for Federal agencies. State and NGO respondents more frequently described their work as regional (Table 6). Respondents with local government and fire response were more likely to name a single community as their scale of work, though only six respondents selected this as their primary scale.

Table 6. Primary scale of work reported by respondents. Columns add to 100. Colored cells are significantly higher (green) or lower (red) than the combined percentage.

Scale	All	Federal	State	NGO	Local	Fire	Other	Count
Single community	5%	0%	0%	5%	12%	12%	5%	6
Several communities	9%	11%	0%	0%	12%	6%	20%	10
Single jurisdiction	22%	25%	27%	11%	35%	38%	0%	25
Multiple jurisdictions	40%	61%	33%	21%	29%	38%	45%	46
Interacts with region	23%	4%	40%	63%	12%	0%	30%	27
Unrelated	1%	0%	0%	0%	0%	6%	0%	1
	100%	28	15	19	17	16	20	115

Respondents described in their own words the scale at which their work tended to focus, which are briefly described below.

Single community: Work focused at community and local levels, including tribal communities, townships, and private and incorporated communities. Some geographic locations mentioned included:

- "The Warm Springs Reservation and less intensely the ceded lands and other tribal properties in the vicinity."

- "The community of Sunriver."

- "Black Butte Ranch is an 1800 acre mix of Ponderosa forest, pastured meadows, and aspen groves with 1353 homes and 20 or so varying association buildings to support the community."

Multiple communities: Worked focused across various municipalities and counties, including unincorporated communities, multiple communities surrounding Deschutes National Forest, and multiple communities on the Warm Springs Reservation.

- "Our jurisdiction is Deschutes County. However, we plan to support neighboring counties in developing recovery plans."

- "I work with the communities that are adjacent to the Deschutes National Forest."

- "Mostly on the Warm Springs Reservation, but also partners with surrounding jurisdictions."

Single jurisdiction: Wok focused within ranger districts, and communities adjacent to USFS serviced lands, BLM managed lands, as well as other private and unincorporated lands.

- "Our protection district on the Prineville Unit and Sisters sub-unit cover portions of Jefferson, Crook, and Deschutes counties."

- "Our fire district is approximately 450 square miles including the communities of Powell Butte, Lone Pine, Prineville, and Juniper Canyon."

- "Primarily my work is within the Fire District that is 140 square miles in size with approximately 30,000 constituents in the rural and suburban area that surrounds the city of Bend, Oregon."

Multiple jurisdictions: Work focused on mitigating wildfire risk transmission and involving coordination among state and federal agencies, including the NRCS, USFS, and BLM.

- "My area of focus is from the Columbia River to the North, Cascade Crest to the West, Northern Klamath and Lake counties to the South, and the John Day River area to the East. And all the communities located within that 11 million-acre footprint."

- "I work with ALL fire agencies, from federal to local protection jurisdictions, to provide prevention information to all Oregon residents and tourists. We have a statewide scope, so our reach is not limited to Central Oregon."

- "I cover the entire state of Oregon including Central Oregon."

Regional: Many respondents at this scale were involved in outreach and research activities. Furthermore, some stakeholders working at this scale were from outside of Oregon.

- "My work is focused across 17 states and the Pacific Islands involving local, state, tribal, and federal land and fire management agencies as well as NGOs."

- "I work nationally on these issues. Several people and entities in Central Oregon, as well as the state of Oregon, are engaged in our learning network."

- "We are a fire and aviation facility that supports wildland fire agencies at local, state, and national levels"

3.1.5. Gender in wildfire risk management

Approximately two-thirds of respondents were male and one-third female. Far more males responded for local government (82%) and local fire departments (100%) while far more women responded who were affiliated with NGOs (78%).

Table 7. *Gender reported by respondents. Columns add to 100. Colored cells are significantly higher (green) or lower (red) than the combined percentage.*

Gender	All	Federal	State	NGO	Local	Fire	Other	Count
Male	65%	63%	73%	22%	82%	100%	60%	74
Female	35%	37%	27%	78%	18%	0%	40%	39
	100%	27	15	18	17	16	20	113

3.1.6. Cultural positions in wildfire risk management

Past work has shown that these cultural viewpoints strongly influence how homeowners view and act on risk (e.g., from wildfire) and is based on the notion that not all people think about risk in the same way. Four poles have been identified: Hierarchies are more willing to defer experience and authority. Egalitarians favor broad participation in decisions, seeking consent and compromise over top-down decisions. Individualists are disinclined

towards outside prescriptions and value efficiency and expediency. Fatalists view risks as chance events that can't be controlled but can be guarded against. Towards this end, we asked a bank of 12 questions that have been effective in eliciting these preferences among homeowners. These questions were included with the wildfire risk management network survey to examine ties between the network and residents.

Of the four cultural positions, we found respondents disagreed with most statements regarding purely top-down or individualist decision-making, nor did respondents view risk as entirely based on chance and beyond control. There was, however, substantial variability in egalitarian views describing the degree with which power (e.g., wealth) should be equally distributed. We note that many respondents noted some discomfort in answering these questions, with many stating that these questions felt irrelevant or that their agencies or organizations discourage employees from making personal or political statements. These points make clear that while cultural viewpoints do influence individual actions, they may not be as relevant to individuals operating in a professional context.

To examine cultural differences among different organizational groups in the management network, we assigned all respondents to each of the four cultural viewpoints based on whether their response was above or below the average of all respondents. Thus, for example, while most people disagreed with hierarchical statements, we identify approximately half of respondents as hierarchs (i.e., those that disagree less). The culture group questions showed that Federal organizations and NGOs were less likely to be hierarchical, while State organizations were more likely to be both hierarchical and hold fatalist views. Federal organizations leaning towards individualism, and NGOs leaning away from it. We didn't observe any organizational groups that leaned towards egalitarianism, although state and local fire organizations were more likely to lean away.

Table 8. *Differences in culture viewpoints among affiliation groups. Colored cells are statistically higher (green) or lower (red) than the overall percentage.*

Culture groups	All	Federal	State	NGO	Local	Fire	Other
Hierarch	49%	38%	71%	38%	60%	53%	44%
Fatalist	49%	50%	64%	44%	53%	40%	44%
Individualist	45%	58%	57%	31%	40%	40%	38%
Egalitarian	41%	46%	29%	50%	47%	27%	44%
	NA	27	15	18	17	16	20

3.2. The geography of wildfire risk in Central Oregon

This section of the report examines the results of a mapping exercise that comprised the second section of the questionnaire. The mapping exercise asked respondents to identify up to 10 locations within Central Oregon that are particularly vulnerable to fire, and up to 10 additional locations believed to be particularly resilient. In this section, we answer the

following questions: (1) Where does wildfire risk management perceive vulnerability of fire to be concentrated within Central Oregon? (2) Where does wildfire risk management perceive resiliency of fire to be concentrated within Central Oregon?

3.2.1. Which areas do you consider to be most vulnerable or most resilient to wildfire in Central Oregon?

Respondents reported 521 locations vulnerable to wildfire, and 146 locations resilient to wildfire in the region. The number of vulnerable locations reported by each respondent ranged from 1 to 10, with a mean of 5.7, while the number of resilient locations reported by each respondent ranged from 1 to 10, with a mean of 3.1. Vulnerable points were more spread out through the region while resilient points were more focused around the communities of Bend, La Pine, and Sisters.
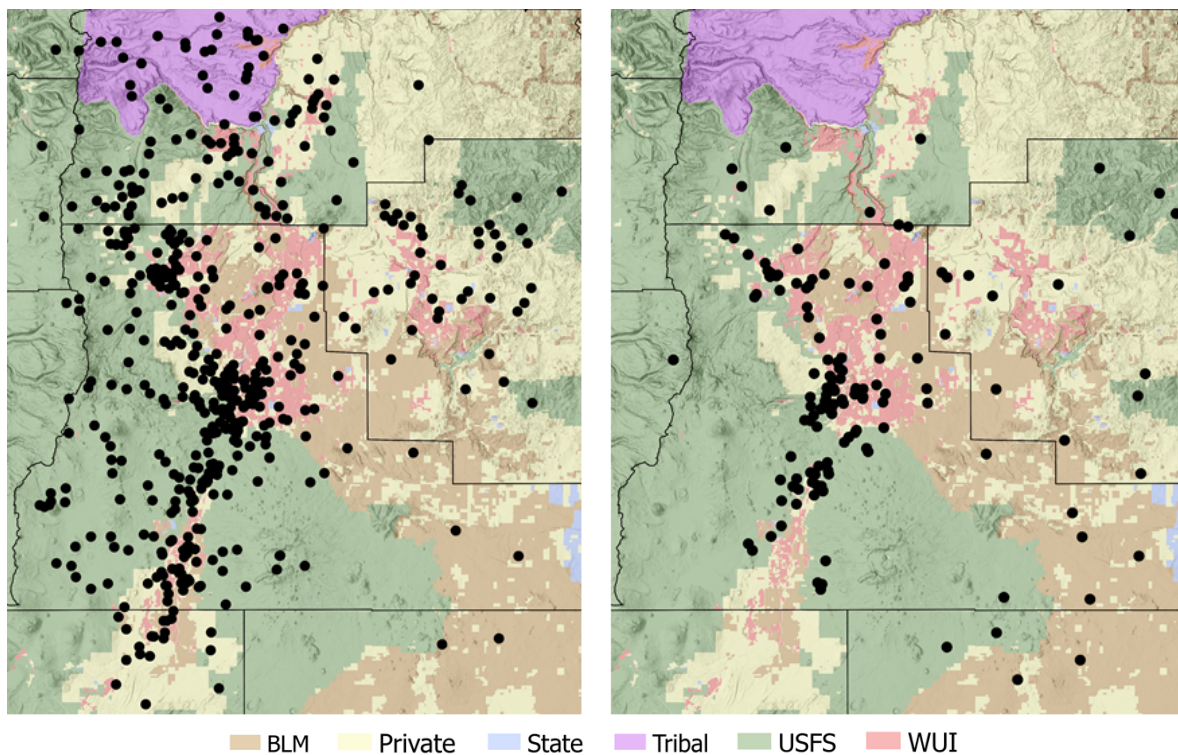
Figure 3. *Vulnerable locations (left) and resilient points (right) in Central Oregon.*

In general, the abundance of vulnerable and resilient points placed on each ownership was closely aligned with the amount of land they manage in Central Oregon with the exception of the WUI, which took up almost the smallest area of land (.2% more than tribal) but received the third most vulnerable and resilient points when compared to the other ownerships. Both vulnerable and resilient points were most frequently identified on USFS lands (40% and 42% respectively), followed by private lands (30% and 25% respectively) and WUI areas (18% and 5.1% respectively) (Table 9). Federally-affiliated respondents were far more likely to report vulnerable and resilient points within USFS owned land. Local government respondents reported a greater number of vulnerable points on USFS

owned land than most other respondents and no areas of resilience. Vulnerable points outnumbered resilient points by 521 to 146, showing a high perception of vulnerability to wildfire in Central Oregon with notable pockets of resilience along in Sisters, Bend, and Sunriver.

Table 9. Number of mapped vulnerable and resilient locations, as well as total mapping respondents by affiliation (A), land ownership where vulnerable points were reported (B) and land ownership where resilient points were reported (C) Values in (B) and (C) represent the percent of reported work locations that occurred in each land ownership category. The percentages listed in the row labels represent the percent of Central Oregon within each tenure (sums to 100%). Colored cells are significantly higher (green) or lower (red) than the combined percentage.

Overall (A)

Counts	Count	Federal	State	NGO	Local	Fire	Other
Mapping respondents (n)	125	36	19	22	21	20	26
Vulnerable locations (n)	544	179	96	81	100	97	106
Resilient locations (n)	149	110	37	40	48	39	37

Vulnerability (B)

Ownership	All	Federal	State	NGO	Local	Fire	Other	Count
USFS (43.5%)	40%	55%	35%	39%	50%	19%	31%	208
Private (27.9%)	30%	24%	40%	29%	31%	40%	24%	158
WUI (5.1%)	18%	15%	15%	12%	9%	33%	24%	94
BLM (17.9%)	7%	4%	4%	17%	9%	8%	6%	36
Tribal (4.9%)	5%	2%	6%	3%	1%	0%	16%	25
(23 pts omitted)	100%	137	78	59	80	78	89	521

Resiliency (C)

Ownership	All	Federal	State	NGO	Local	Fire	Other	Count
USFS (43.5%)	42%	72%	18%	53%	0%	0%	31%	62
Private (27.9%)	25%	11%	45%	24%	35%	39%	38%	36
WUI (5.1%)	24%	12%	36%	24%	45%	28%	31%	35
BLM (17.9%)	9%	5%	0%	0%	20%	33%	0%	13
Tribal (4.9%)	0%	0%	0%	0%	0%	0%	0%	0
	100%	64	11	17	20	18	16	146

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Despite occupying only about 5% of the landscape, the WUI had a profound impact on where participants mapped vulnerable and resilient locations. Of all vulnerable and resilient locations reported, 40% and 21% respectively occurred within the WUI, and more than 90% of vulnerable and resilient locations were within 5 miles of the WUI (Table 10). Significantly more vulnerable points were placed inside the WUI by both federally and locally-associated respondents than other affiliations. On the contrary, fire and other-associated respondents placed less vulnerable points and significantly more resilient points inside the WUI. It bears noting that the magnitude of these numbers reflects the extensive geographic coverage of the WUI in the region. So while only 5% of the study is classified as WUI, almost a third of land (31%) is within 5-miles, a distance easily traveled by fire during extreme conditions.

Table 10. *Percentage of vulnerable locations (A), and resilient locations (B), reported inside the WUI, within 1-mile, 2.5-miles, or 5-miles of the WUI for each affiliation type. The percent listed in the row labels describes the percentage of Central Oregon within listed distances to the WUI. Colored cells are significantly higher (green) or lower (red) than the combined percentage.*

Vulnerability (A)

Distance to WUI	All	Federal	State	NGO	Local	Fire	Other	Count
In the WUI (5% region)	40%	55%	35%	39%	50%	19%	31%	208
< 1-mile (12% region)	30%	24%	40%	29%	31%	40%	24%	158
< 2.5-miles (13% region)	18%	15%	15%	12%	9%	33%	24%	94
< 5-miles (31% region)	5%	2%	6%	3%	1%	0%	16%	25
	100%	137	78	59	80	78	89	521

Resilience (B)

Distance to WUI	All	Federal	State	NGO	Local	Fire	Other	Count
In the WUI (5% region)	21%	18%	17%	14%	11%	33%	26%	94
< 1-mile (12% region)	41%	41%	43%	29%	46%	42%	39%	186
< 2.5-miles (13% region)	22%	18%	26%	33%	28%	17%	20%	102
< 5-miles (31% region)	16%	23%	13%	24%	15%	8%	15%	75
	100%	114	69	51	65	78	80	457

The top reasons that respondents cited for locations being vulnerable were probability (84%) and fuels (71%). Both of these stood far above all other reasons, with four of them: absentee, awareness, management, and coordination, all having less than 20% of respondents choosing them. This is worth noting, especially given the overlap of some of these reasons. For example, fuels are a widely cited reason, which you would think could

be handled with management, however, almost no one cited management as a reason for vulnerability. Interestingly, management was the top choice for why places are resilient (61%). Federally-affiliated respondents rarely identified management as a reason for vulnerability overwhelmingly chose it as a reason for resiliency, indicating that forest managers are quick to contribute success to management while ignoring the effect that management could potentially have on mitigating our vulnerability to wildfire in Central Oregon. State and locally-affiliated respondents were much more likely to attribute development as a reason for resiliency (30% and 32% respectively), which brings into question how more local individuals may view development and its impact on wildfire resilience.

Table 11. *Reasons cited for vulnerable locations (A) and reasons cited for resilient locations (B). Rows do not add to 100. Colored cells are significantly higher (green) or lower (red) than the combined percentage.*

Vulnerability (A)

Reasons for vulnerability	All	Federal	State	NGO	Local	Fire	Other	Count
Probability	84%	84%	69%	89%	84%	88%	91%	391
Fuels	71%	67%	69%	61%	68%	76%	83%	330
Vulnerable	43%	27%	24%	59%	51%	44%	63%	198
Development	42%	29%	27%	48%	53%	51%	51%	193
Egress	33%	33%	24%	24%	38%	58%	21%	154
Space	32%	22%	31%	22%	54%	50%	22%	151
Materials	25%	10%	9%	41%	24%	35%	42%	114
Terrain	22%	15%	9%	26%	29%	32%	23%	100
Absentee	18%	11%	13%	46%	19%	7%	28%	86
Awareness	17%	8%	4%	43%	18%	8%	35%	81
Management	14%	16%	4%	43%	10%	3%	14%	64
Coordination	13%	16%	13%	35%	4%	3%	12%	60
NA		126	67	46	68	72	86	465

Resiliency (B)

Reasons for resiliency	All	Federal	State	NGO	Local	Fire	Other	Count
Management	61%	88%	30%	54%	42%	25%	39%	81
Awareness	46%	38%	50%	31%	58%	42%	72%	61
Engaged	45%	40%	30%	31%	63%	33%	67%	59
Vegetation	44%	47%	50%	31%	21%	25%	78%	58

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	All	Federal	State	NGO	Local	Fire	Other	Count
Coordination	42%	32%	50%	46%	63%	50%	39%	55
Fuels	35%	38%	60%	15%	42%	50%	6%	46
Egress	31%	22%	30%	8%	63%	50%	33%	41
Materials	11%	2%	0%	8%	16%	8%	50%	15
Development	9%	0%	30%	0%	32%	17%	6%	12
	NA	60	10	13	19	12	18	132

3.3. Mapping the wildfire risk management network

This section of the report examines the management network. Federal initiatives like the National Cohesive Strategy emphasize the importance of strategically aligning goals, programs, and actions across jurisdictions, encouraging collaboration across organizations, and coordinating programs across scales. Although formal mechanisms have been deliberately developed to encourage these outcomes (e.g., the national Fire Adapted Communities Learning Network), much of these outcomes result from the coordinated work of individuals and organizations preparing for, responding, and recovering from wildfire. Respondents described 846 working ties among the 210 individuals making up the Central Oregon wildfire risk management network.

3.3.1. Network ties and their reported influence and frequency

Respondents identified up to 20 individuals they have worked with in the past 5 years on issues related to core 'domains' identified in the National Cohesive Strategy: fire-resilient landscapes, fire-adapted communities, safe and efficient fire response. Of these ties, 31% were identified as partners in achieving resilient landscapes, 43% as partners working towards fire-adapted communities, and 24% as partners in response to wildfires. Compared to other groups, Federal respondents most often identified individuals in the resilient landscape domain, State and local fire respondents were more likely to report partnerships in the response domain, while NGO and local government were more likely to identify partnerships addressing fire-adapted communities.

Table 12. *Domains of nominated individuals, grouped by affiliation of the respondent that nominated them. Columns do not sum to 100. Colored cells are significantly higher (green) or lower (red) than the combined percentage.*

Domain	All	Federal	State	NGO	Local	Fire	Other	Count
Landscape	33%	42%	34%	26%	27%	26%	33%	275
FAC - People	28%	24%	18%	41%	27%	26%	32%	235
FAC - Building	15%	9%	14%	17%	23%	16%	17%	129
Response	24%	26%	33%	16%	24%	32%	17%	207
	100%	229	90	125	127	142	133	846

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The most often cited roles that respondents identified in these partnerships were implementing and responding (16% for each). The spread of those that chose implementing was very even, with only locally-affiliated respondents having significantly less select it, and responding was most often cited by state and federally-affiliated respondents. Convening and assessing were the least cited roles, with 8% each. NGOs selected authorizing far more than any other roles, and least often chose responding and assessing. Overall though the choice of role was pretty evenly spread, with only an 8% difference between the most and least often selected choices. Note that no role was reported for 126 working relationships.

Table 13. *Role of past work with nominated individuals, grouped by affiliation of the respondent that nominated them. Columns do not sum to 100. Colored cells are significantly higher (green) or lower (red) than the combined percentage.*

Role	All	Federal	State	NGO	Local	Fire	Other	Count
Implementing	16%	16%	20%	17%	11%	15%	19%	117
Responding	16%	26%	21%	2%	19%	14%	12%	117
Authorizing	15%	8%	11%	34%	6%	19%	15%	108
Coordinating	15%	12%	16%	15%	13%	18%	16%	106
Engaging	11%	10%	9%	11%	13%	9%	13%	79
Planning	11%	10%	11%	10%	14%	10%	9%	77
Assessing	8%	8%	6%	3%	18%	10%	5%	59
Convening	8%	9%	6%	8%	6%	6%	11%	57
	100%	196	70	118	106	108	122	720

3.3.2. Structural characteristics of the wildfire risk management network

We found that 31% of all relationships in the network were between members of the same affiliation, although the tendency for people to form relationships with others of a similar professional affiliation varied by group (Table 14). The highest degree of within-group work occurred among Federally-affiliated individuals, although similarly high within-group work was reported within local and state government (40% and 34% respectively). By contrast, working relationships within NGOs and local fire tended to be more diverse, with 78% and 86% of their relationships respectively being outside of their affiliation. The majority of ties among organizations were reciprocal, with most ties between affiliations being close to 10% to 20%.

Table 14. *Relationships within and between affiliations groups (each row % adds to 100). Cells along the diagonal represent working relationships within-group; Total work relationships outside of respondent affiliation listed on the far right.*

From ⇩	To ⇨						Not in-group
	Federal (184)	State (100)	NGO (93)	Local (243)	Fire (124)	Other (89)	
Federal (221)	91 (41%)	13 (6%)	16 (7%)	52 (24%)	34 (15%)	15 (7%)	59%
State (89)	19 (21%)	30 (34%)	3 (3%)	19 (21%)	13 (15%)	5 (6%)	66%
NGO (125)	14 (11%)	5 (4%)	28 (22%)	44 (35%)	21 (17%)	13 (10%)	78%
Local (126)	17 (14%)	16 (13%)	13 (10%)	50 (40%)	18 (14%)	12 (10%)	60%
Fire (142)	27 (19%)	19 (13%)	21 (15%)	49 (35%)	20 (14%)	6 (4%)	86%
Other (130)	16 (12%)	17 (13%)	12 (10%)	29 (22%)	18 (14%)	38 (29%)	71%

We graph the network using the data provided by survey respondents and breaking the network into different affiliation groups (Figure 4). These network diagrams illustrate how individuals (and organizations) relate to one another and the relative centrality of actors within the overall network. The layout of the diagram is based on the working ties that exist between two collaborators. These ties act like springs that "pull" work partners closer together in the diagram, thereby creating a usual approximation of social proximity within the management network. A bullseye pattern helps gauge relative positions in the network and divides the network into four quadrants.
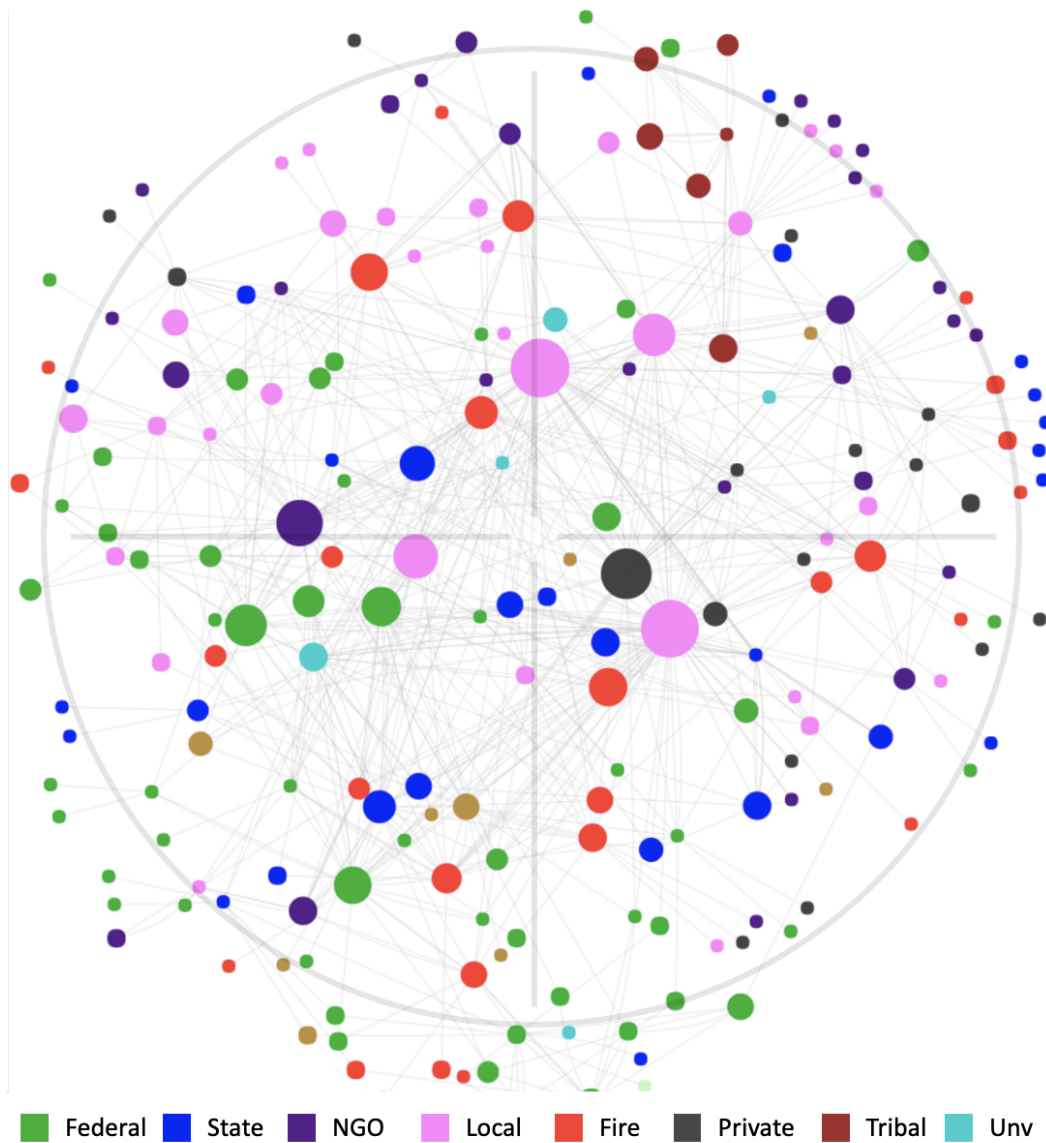
Figure 4. *The full network (upper left) and within- and between-group affiliation networks (small multiples) show the breadth, reach, and centrality of each organization type, in addition to areas of overlap. Green = USFS; Brown = BLM; Blue = State, Teal = University; Purple = NGO; Magenta = Local; Red = Fire Districts; Black = Private*

Dividing the network diagram by affiliation groups illustrates where individuals from different affiliations are located in the network (Figure 5). In general, individuals located in different quadrants of the network are less likely to collaborate, share information, or frame wildfire management in a similar light. For instance, federal actors are located at the bottom two quadrants of the network diagram, which contrasts with NGOs who tend to occupy the top half. Similarly, state actors are located in the left half of the network while private actors (a major component of the "others" group) are found on the right half. Partners of these individuals are, by contrast, more evenly distributed across the network. Local government and local fire are the most evenly distributed among the groups, with the

former being particularly central to the network. The distribution of these points differs substantially from other areas that we have surveyed. For example, in North Central Washington, the distribution of NGO-affiliated individuals was more similar to that of local government in Central Oregon, while in Northern Utah, Federal actors were some of the most central while the state was most broadly distributed.
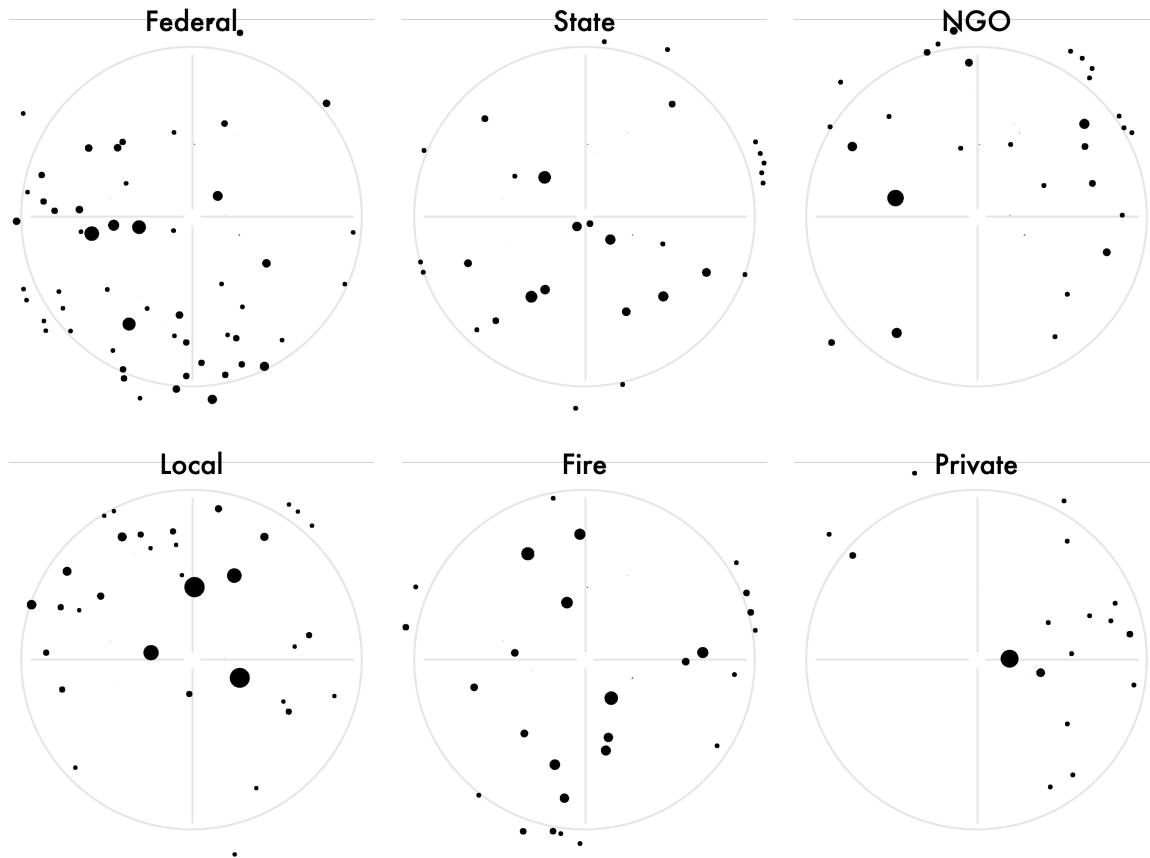

Figure 5. The full network is divided into affiliation groups. A bulls-eye pattern overlays each panel to provide reference.

Looking at the roles played by individuals in different quadrants of the network presents a different picture. The locations of individuals remain the same as in the previous figures, although the size of their node has been modified to reflect how many times they were identified as playing a particular role in wildfire risk management. The order of roles reflects Table 13, with implementation being the most frequently cited and assessing being the least. Generally speaking, roles are broadly distributed around the network, although some are more dispersed and others are more concentrated. Coordination, for instance, is broadly distributed and lacks the central role of specific individuals, such as that seen in response, authorization, engagement or planning. Implementation, authorization, and

assessment tend to occupy left and bottom quadrants, while authorization, coordination, and convening tend to occupy the upper quadrants.
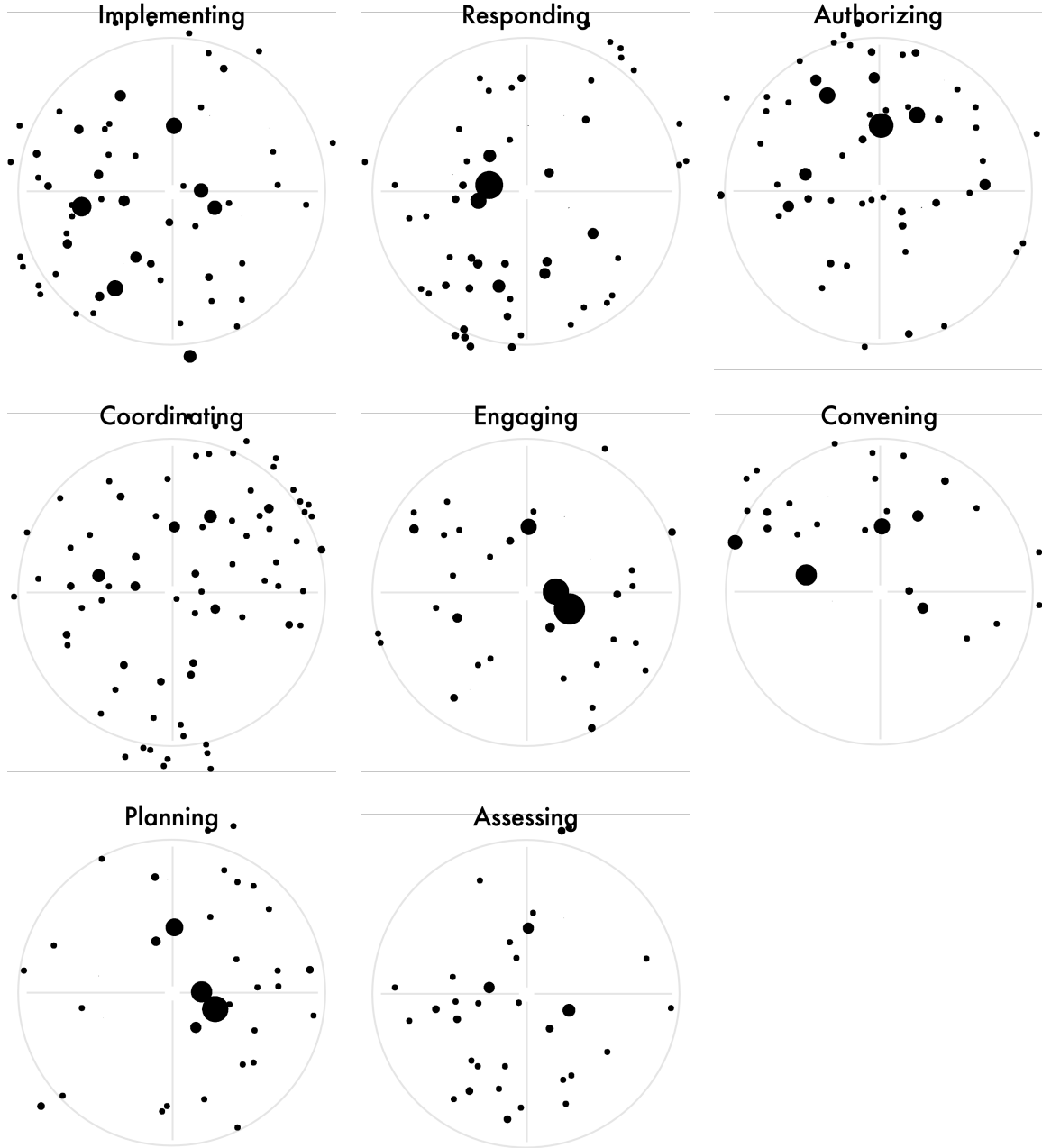
Although the network illustrations help visualize the location of each affiliation's members in the network, we also used each members' nominations to compute metrics of centrality and betweenness. These metrics identify (1) which affiliations tend to be most central and most boundary spanning, and (2) wherein the network are the most central and boundary-spanning individuals? Slightly less than half of network members were only nominated once to the network (n=107; low centrality), whereas 19% of network members were nominated at least 5 times (n=38; high centrality). Of those members identified more than 5 times, members from local fire response, federal-agencies and local government were the most common (24%, 24%, and 21% respectively). Centrality was particularly concentrated within 4 local government actors and one private contractor funded by Deschutes County. Betweenness, as opposed to centrality, depicts the importance of specific individuals in bridging to areas of the network that might not otherwise be connected. Both centrality and betweenness are strongly linked to overall influence.
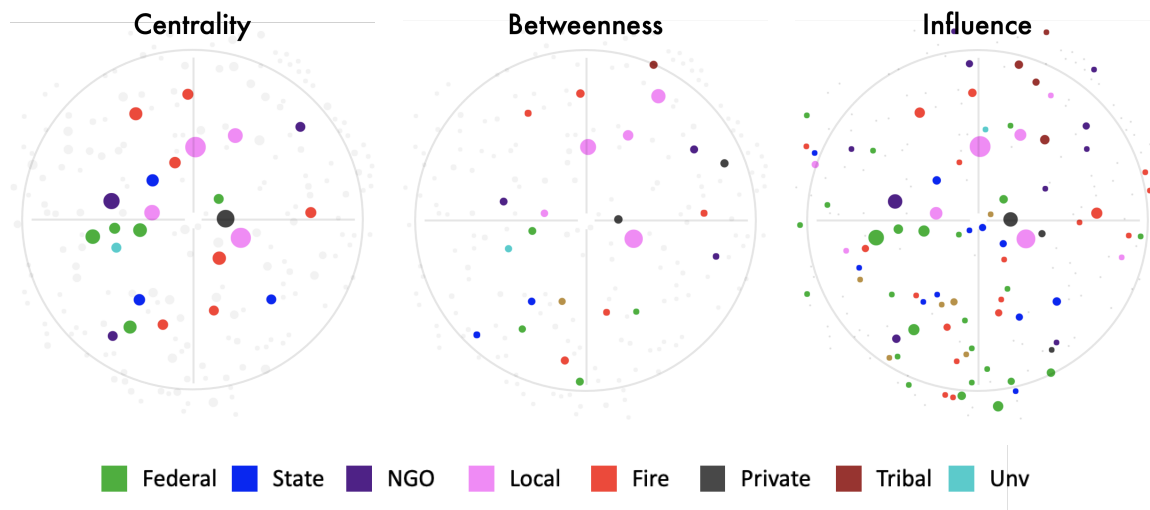

Figure 7. Important individuals within the wildfire management system as identified by the number of times they were identified (n=44). Those individuals that also act as boundary spanners are circled in black (n=22). Boundary spanners sit on a pathway between otherwise disconnected members.

4. Conclusions

Management of wildfire risk increasingly relies on collaboration among different institutions, agencies, organizations, and groups. We surveyed participants in the Central Oregon wildfire management system to understand who is participating in that system, where different organizations are working on the landscape, and how people partner across organizational boundaries. This research shows that the wildfire management network in Central Oregon (1) spans governmental agencies working at multiple scales; (2) concentrates around the wildland urban interface and adjacent national forest and demonstrates opportunities for shared stewardship, and; (3) is held together by a relatively small set of individuals who play an outsized role in bridging boundaries between the different organizations that play a role in managing wildfire risk.