Co-Management of Fire Risk Transmission (CoMFRT)

Project Summary Report 2018-2022

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"Successfully living in fire-prone landscapes is only possible when the various locally situated organizations and agencies that deal with wildfire risk can work collaboratively across boundaries"

-National Cohesive Wildland Fire Management Strategy

Executive Summary

The importance of the USDA Forest Service (USFS) working across boundaries with other federal, tribal, state, and local agencies, individual residents, as well as private businesses and non-governmental organizations to address wildfire risk and build community resilience to wildfire has been emphasized in long-standing documents like the interagency National Cohesive Wildland Fire Management Strategy and more recently USFS priorities like Shared Stewardship, the Wildfire Crisis Strategy (WCS) , and the fire-related provisions of the Infrastructure Investment and Jobs Act (IIJA]). In 2017, USFS Fire and Aviation Management (FAM) piloted The Co-management of Fire Risk Transmission (CoMFRT) partnership - a unique effort - created to explore the establishment of a long-term social science research program on community capacity and resilience to address cross-boundary wildfire risk in fire-prone areas that could inform fire-related agency programs and investments. CoMFRT was established to go beyond traditional "one-off" and short-term studies by creating a long-term coordinated multi-scaled, interdisciplinary, longitudinal applied research program. This demonstrates USFS FAM's ability to lead the way on innovative applied social science work to inform the social components of wildfire risk as they relate to reaching internal and interagency goals. The purpose of this report is to share content, including findings and recommendations from the empirical fieldwork to date, with key USFS leadership staff regarding future directions of the CoMFRT Partnership that will support the strategic direction of USFS (including the Wildfire Crisis Strategy [WCS] and implementation of fire-related provisions of the Infrastructure Investment and Jobs Act [IIJA]) as well as the enduring interagency goals outlined in the National Wildland Fire Cohesive Strategy.

Taken as a whole, the work of the CoMFRT Partnership reflects an approach to study the social architecture at a variety of scales at which the cross-boundary nature of wildfire risk is managed (Essen et al., 2021). Working from the most local level, parcel-level observations and paired household survey data provide insights into Individual-level (household) decisions and actions that shape wildfire risk on private residential properties. These household level data reveal a great deal of diversity in levels and perceptions of risk and where and how households acquire and use fire risk information. When linked with community level assessments that diversity shows significant differences in the cross-boundary wildfire mitigation actions that local collaborators can enact across diverse social and biophysical conditions. In other words, there appear to be distinct 'pathways' that diverse community leaders and fire professionals can use to implement wildfire management strategies at a community or landscape level. This work suggests that assessment tools are needed to help communities "customize" their strategies for building capacity and resilience to wildfire exposure in ways that are specific to their particular context as revealed by the household and pathways data.

In addition, many local practitioners who work with fire-prone communities are connected to and participate in various wildfire-related practitioner networks. Social network mapping shows which organizations are engaged in addressing fire risk across the landscape and helps to identify boundary-spanning individuals who are especially helpful in connecting smaller groups of people into a larger governance network. These networks also function within a broader regulatory and policy context that

potentially provides programs, tools, and resources to these networks. To better understand how these resources are being or can be deployed interviews with "boundary-spanners" in the network were consistent with other interviews with wildfire managers and policymakers at other governance scales. Specifically, participants discussed the importance of collaboration as a tool, but they warned that collaboration takes time and resources that many agencies and other stakeholders lack. These interviews also revealed a possible disconnect between the landscape-scale governance and the perspective of regional and/or national scale policymakers. Interviews at larger scales suggested that policymakers are more supportive of collaboration than many stakeholders perceive, but that policymakers struggle to turn national level programs into landscape scale directives.

Fieldwork completed in the two study sites highlight important lessons to support building fire adapted communities and surrounding landscapes to better live with wildland fire. Findings demonstrate that this cannot be achieved by primarily focusing on biophysical mitigation strategies (e.g., fuel treatments) independent of the social context of wildland fire exposure. By interconnecting our various team investigations within a multi-scale social system, the CoMFRT strategy can generate a more complete, albeit local, understanding of the various social structures, or the architecture, and associated functions of wildfire governance as a multi-scaled system.

Part 1. Introduction

What is the Co-Management of Fire Risk Transmission (CoMFRT) project?

The USDA Forest Service (USFS) is the largest wildfire management agency in the United States. Despite this, it does not have sole responsibility and authority to fully address wildfire risk in the US. Instead, the USFS is part of a complex network of public, private, and tribal agencies and organizations, each having varied roles in addressing wildfire risk across diverse fire-prone landscapes. Thus, to successfully address wildfire risk these co-dependent actors and organizations must learn how to work effectively together to achieve better outcomes.

The reach these goals, the CoMFRT Partnership is designed to study the cross-boundary nature of addressing wildfire risk through the multi-scaled networks, or the existing social architecture, at which various risk mitigation decisions are made (see Figure 1.1). CoMFRT is a unique opportunity to gain insights within and across these scales in ways single studies are unable to complete. For example, mitigating risk in fire-prone landscapes involves interactions and coordination among public, tribal, and private agencies and organizations that operate at a variety of social and institutional scales (not unlike ecological scales) that have varying abilities and responsibilities to affect factors key in addressing wildfire risk, such as likelihood, intensity, and fire effects. Moreover, the suite of agencies and organizations working on wildfire risk vary from place to place. We expect the network of agencies and organizations focused on addressing wildfire risk in Eastern Washington to be different from a wildfire risk network in Tucson, Arizona. Each network is comprised of various people and organizations such as homeowners, local fire protection authorities, county and state agencies, water management authorities, tribal agencies and organizations, and federal land management agencies. These organizations and individuals associated with them have varying capacities to make decisions and act on where and how to treat the landscape, including management of fuels. In other words, desired outcomes, like decreasing wildfire risk or building wildfire adapted communities, are not dependent on the USFS in isolation, but instead depend on a suite of interactions across organizations, jurisdictions, land ownerships, and temporal scales. Given this variation among multi-scaled networks, the role of USFS in these networks will also vary.

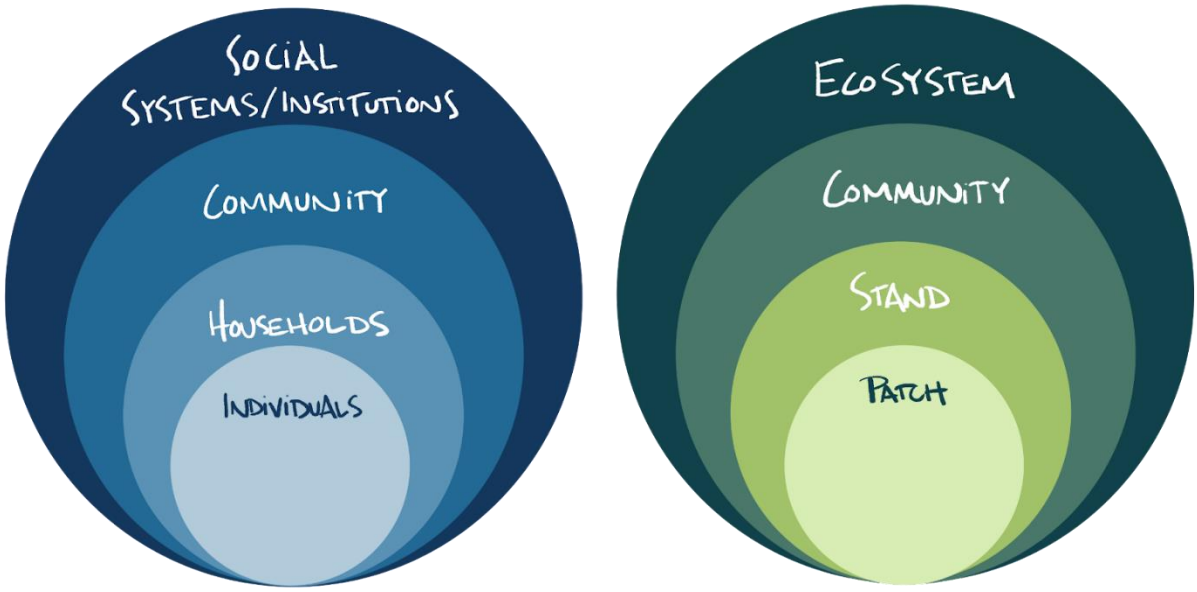


Figure 1.1 A comparison of Ecological and Social/Institutional scales.

CoMFRT offers a unique opportunity to more purposefully invest in understanding the complex interactions required to address wildfire as a cross-boundary risk. For much of the Forest Service's history, agency investments related to wildfire risk have focused on calculating risk based on biophysical characteristics of fire-prone areas, calculating locations that present an opportunity to engage an active fire incident more successfully, and then delivering this information to end users and other decision makers. While these investments have yielded important outputs and insights, they are not designed to take the diversity among various social systems into account nor the varying role the USFS plays in different fire-prone places. As a long-term effort, CoMFRT is purposefully designed to gain insights about varying social geographies of wildfire mitigation and the varying roles of the USFS in those landscapes by generating, place-specific knowledge based on the assumption that no two places are alike in terms of what may support building local capacity to address wildfire challenges. CoMFRT represents the best available social science – accounting for the complex network of public, private, and tribal organizations and individuals making decisions that bear on wildfire risk – in a way that supports the National Cohesive Strategy (NCS), Shared Stewardship, WCS, IIJA, and the agency's goal to better live with wildland fire.

With this framing in mind the specific goals of CoMFRT are to: (1) identify efforts across all governance levels that enable successful collective adaptation to complex wildfire hazards across different land ownerships and jurisdictions in fire-prone landscapes; and (2) provide a) recommendations to local communities and wildfire managers to build fire adapted communities and b) guidance to national level policy (e.g., NCS and WCS) implementation. In sum, this effort is a partnership informed by the best available social science for understanding the formation and operation of complex place-based formal and informal networks of actors and organizations and the USFS's role in these networks and social systems. This knowledge enhances the Agency's ability to address wildfire risk to meet the moment in a way that respects and leverages the (social and ecological) diversity of fire-prone landscapes.

Research Approach

Just as ecology and ecological research can be organized according to ecological scales, social science research on cross-boundary wildfire mitigation can be organized at multiple social scales from households to national fire governance agencies and their interactions (Kooiman, 1993). Therefore, CoMFRT organized its fieldwork into four research teams, targeting different wildfire mitigation contexts, for conducting fieldwork and then integrated those insights for each case with each team focusing on different questions, stakeholders, governing agencies, and institutions at multiple geographic and organizational scales. Those teams are:

1. *Wildfire Research (WiRē)* – The WiRē team works with local wildfire education programs to develop proactive, evidence-based programs grounded on understandings of local needs. Such programs work to reduce wildfire risk on private land parcels and increase resident preparedness for a wildfire event.

2. *Community Pathways* – The community pathways team examines how distinct human populations across landscapes form (or do not form) the bonds, shared values, institutions, and processes of interaction that allow them to promote or modify collective action for wildfire.

3. *Social Networks* – The networks team examines how professional stakeholders in wildfire risk management organize to manage cross-boundary wildfire risk.

4. *Multi-Scale and Cross-Boundary Governance* – The Governance Team examines the processes and institutions that support (or constrain) cross-scale and cross-boundary wildfire work, with a focus on identifying policies, programs, and organizational changes that can scale up wildfire risk mitigation.

Site/Case Selection

Initial CoMFRT study site selection began with an analysis (Ager et al. 2019) of wildfire transmission from National Forest administered lands to private lands and structures. From this analysis and the associated map output, CoMFRT selected study sites identified as areas of high fire risk transmission. This report will provide details on the first two study sites, North-Central Washington and Northern Utah, (see Figure 1.2) as data collection is ongoing in the third site. We are also currently collecting data in a third site in west central Wyoming, but do not report findings from that location in this report.

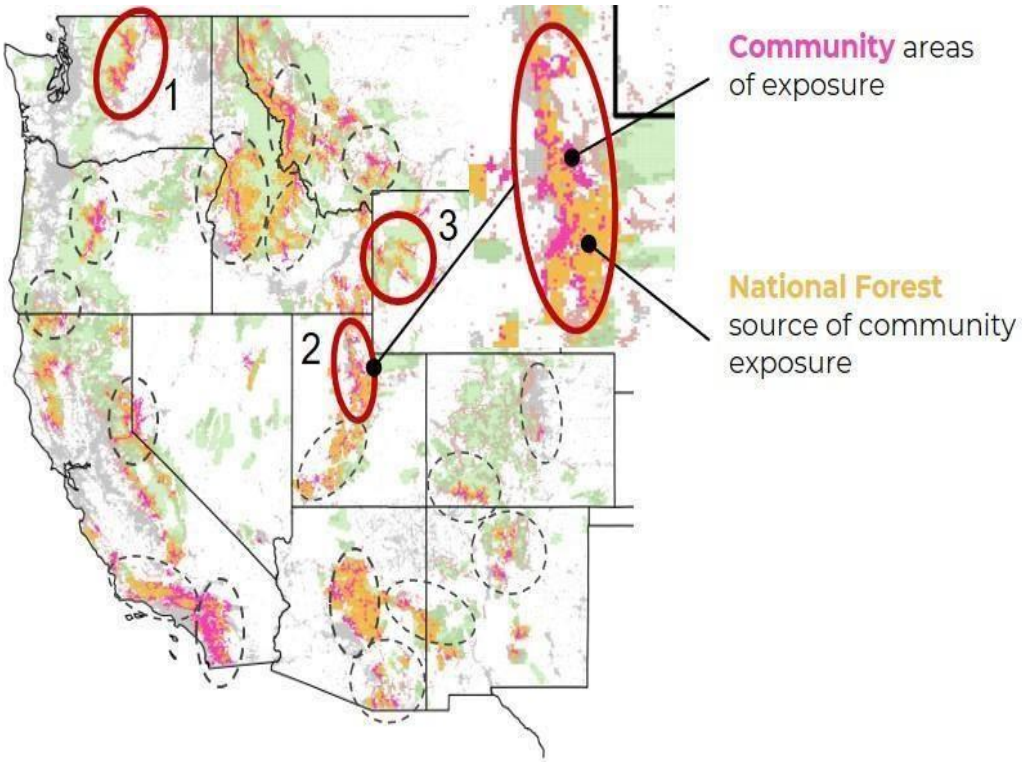


Figure 1.2. National Forest System community wildfire exposure hotspots (red ellipses) of wildfire risk transmission including (1) North-Central Washington, (2) Northern Utah, and (3) West-Central Wyoming. CoMFRT Partnership Study Sites.

Part 2. Key Lessons from Fieldwork

Below we describe high-level lessons gleaned from the two project sites and how these might apply to other places, communities, households, and/or governance levels attempting to promote more cross-boundary wildfire risk management.

WiRē

The WiRē team works with local wildfire education programs to develop proactive, evidence-based programs based on understandings of local needs. Data at the appropriate decision-making scale are critical to enable local wildfire practitioner organizations to develop efficient and effective strategies for community engagement. As such, the extent to which results from WiRē projects can be generalized beyond the study area is limited. Understanding how any single study area is similar or different from other study areas requires adequate data from enough additional study areas to allow for appropriate analyses. Beyond the CoMFRT Partnership project, the WiRē Team is engaged in the pursuit of this possibility through the development of a Master Dataset. WiRē-CoMFRT project data will be added to the WiRē Master dataset. When considering data resulting from WiRē projects with Chelan County, WA Fire District 1 (CCFD1) and in Emigration Canyon (Northern Utah), it is possible to observe important differences in the wildfire risk and response capacity between CoMFRT study communities that may be leveraged to shape programs, practices, and policies that support community wildfire adaptation. Emigration Canyon respondents were more likely to perceive their properties at higher risk, whereas CCFD1 respondents were more likely to support prescribed fire on public lands and believe local firefighters had sufficient resources to respond to wildfires.

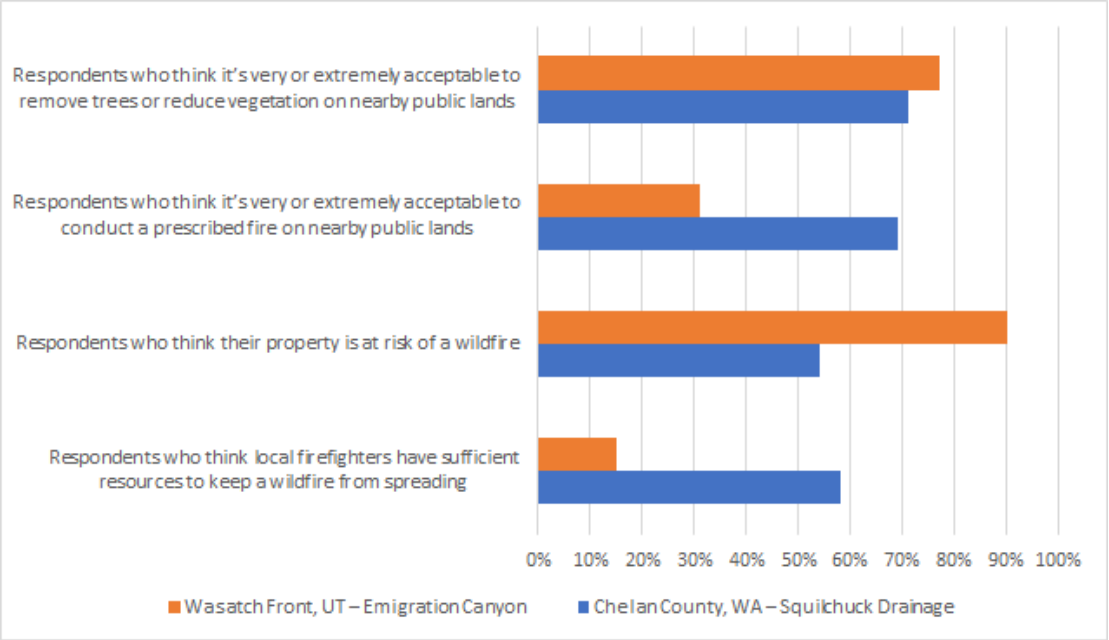


Figure 2.1. Responses to household survey questions from WiRē projects areas in Emigration Canyon, Utah (n=249) and Squilchuck Drainage, Washington (n=293).

Community Pathways

The community pathways team explores how distinct human populations across landscapes form (or do not form) the bonds, shared values, institutions, and processes of interaction that allow them to promote or modify collective action for wildfire. The team develops processes, tools, and procedures that empower human populations to document diverse local contexts, share lessons, and tailor the design or promotion of wildfire mitigations to local conditions in ways that are most likely to be perpetuated by local collaborators.

Key findings from the Community Pathways team include:

1. Documentation of community patterns across a landscape can reveal where collaborative action is currently possible and where more relationship-building or cross-boundary potential might be needed.
2. Research results suggest distinct 'pathway' considerations and actions that diverse communities/professionals can use to implement tailored wildfire management strategies (see Paveglio et al. 2018). Empirical testing and development of pathway components across case studies reveals significant differences in the cross-boundary wildfire mitigation actions that collaborators can enact across diverse social and biophysical conditions (Paveglio et al. 2019a, 2019b). These results are helping to refine and expand the approaches used by the Pathways Team, and could be expanded to provide approaches for enabling, documenting, or monitoring landscape-level progress in creating fire adapted communities (see Paveglio 2021 for details).
3. Other research findings from the community pathways team focus on documenting the conditions or characteristics that inhibit collective action surrounding wildfire (what the team calls "social fragmentation") (Paveglio et al. 2019b). Documenting the opposing forces of social fragmentation and community emergence (or change) influence the scale, patterns,

occurrence, or possibility of cross-boundary action surrounding fire in a broader landscape (Carroll and Paveglio 2019; Paveglio 2021; Billings et al. 2021a, b). Select groups at local levels can provide "bridges" between high-level policymaking and the need to tailor fire adaptation objectives to the scales at which action is currently possible.

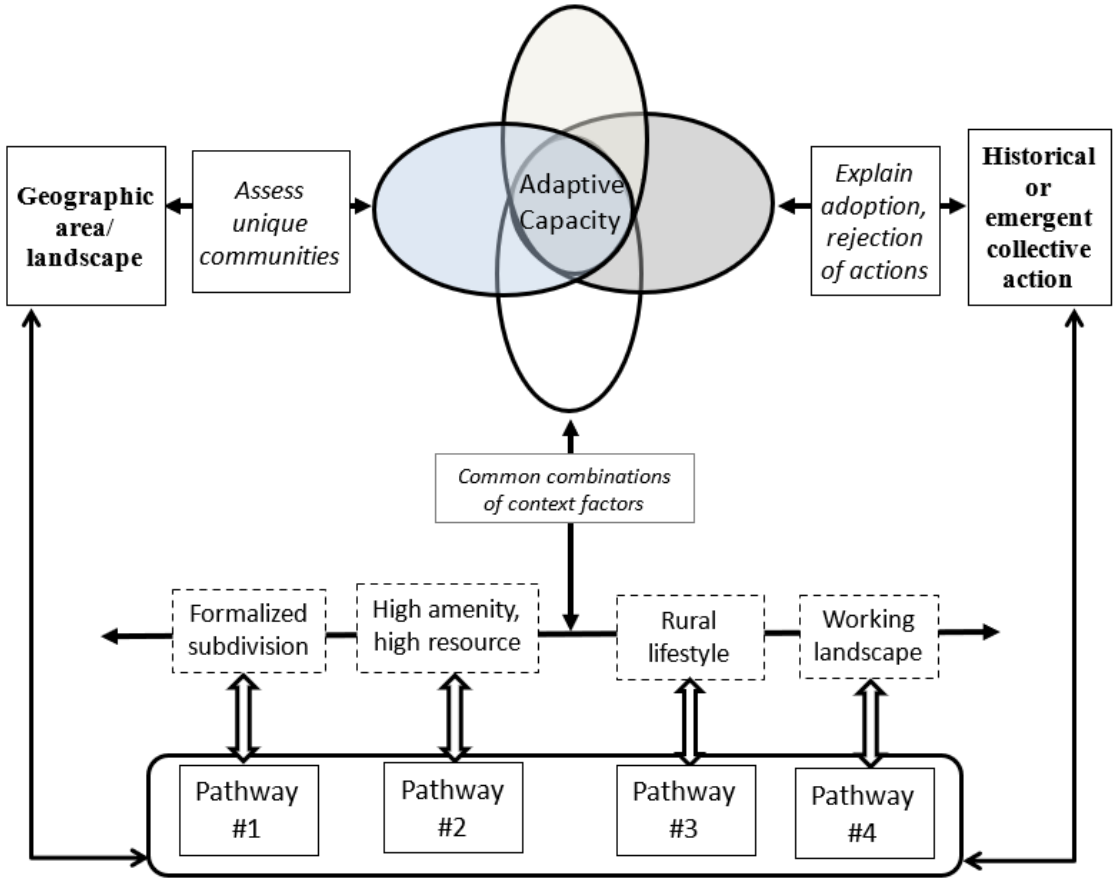


Figure 2.2. Development and uses for the Interactional Approach to Adaptive Capacity (adapted from Paveglio et al. 2018. The approach can be used to determine unique communities in a geographic area, explain emergent or historic collective action, or identify potential strategies best suited to local context through the systematic documentation of local social context. Meta-analysis of cases using the interactional approach has uncovered a continuum of "archetype" communities (e.g., formalized subdivision; high amenity, high resource) that share common combinations of social context. Each "archetype" community would likely have a different "pathway" for fire adaptation.

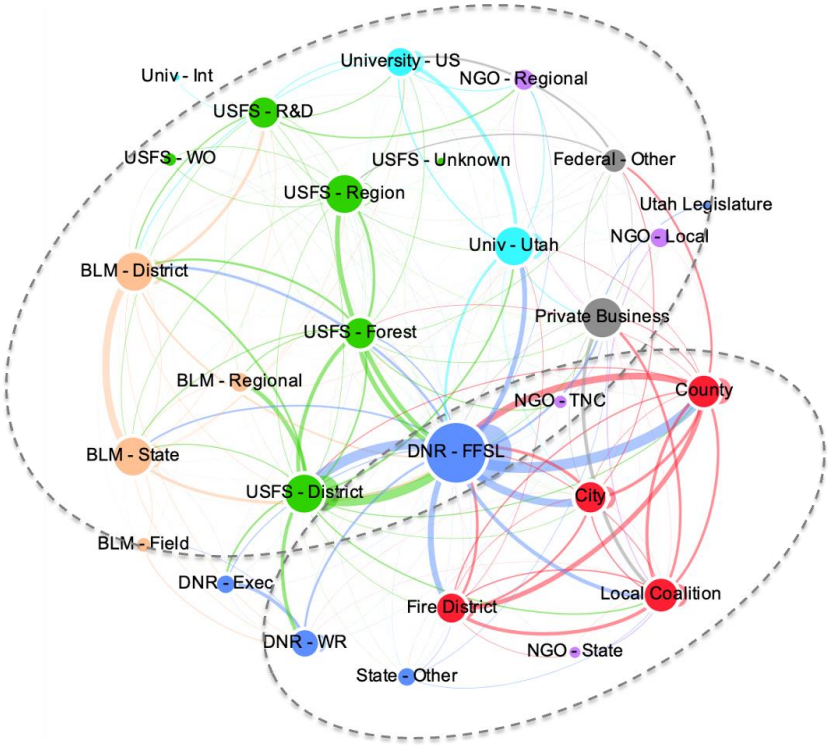
Social Networks

The networks team examines how professional stakeholders in wildfire risk management organize to manage cross-boundary wildfire risk. Managing cross-boundary wildfire risk requires working together across stakeholder interests, organizational affiliations, and other social boundaries to build relationships and identify solutions. The team aimed to identify who is involved in wildfire risk management in each study area, what are their roles, where do they work, and how are they connected to each other? Answers to these questions are represented as a network that illustrates how

organizations and individuals connect across boundaries and are generated from a participatory network mapping exercise.

Findings from both study sites identify diverse extant networks of managers and stakeholders engaged in wildfire risk management. Professionals in wildfire risk management included those working at multiple levels of government at the federal, state, and local levels, as well as in the private sector, non-governmental organizations (NGO), and tribal nations. However, the two study sites in Washington and Utah differ in who plays central roles, who bridges between otherwise disconnected segments of the networks, what roles different actors play, and where they work. For example, northern Utah's network highlights two clusters of organizations that are primarily bridged by the Utah Department of Natural Resources (DNR) but are otherwise largely disconnected. One cluster is composed mostly of federal organizations, while the other is composed of mostly local organizations. In contrast, in north central Washington's network, multiple clusters of organizations are arrayed around a central cluster dominated by a triangle of connections between staff in local fire districts, the Washington Department of Natural Resources, and district offices of the US Forest Service (Figure 2.3).

In addition to highlighting the structure of the network, we also identify lessons about where different actors work on the landscape, and how perceptions of differences in wildfire risk management priorities are associated with lower levels of trust, specifically among groups who are less well represented in the network. These findings highlight both opportunities for increased cross-boundary collaboration among local, state, and federal actors, as well as challenges to strategically enlarging the network of stakeholders engaged in cross-boundary wildfire risk management.



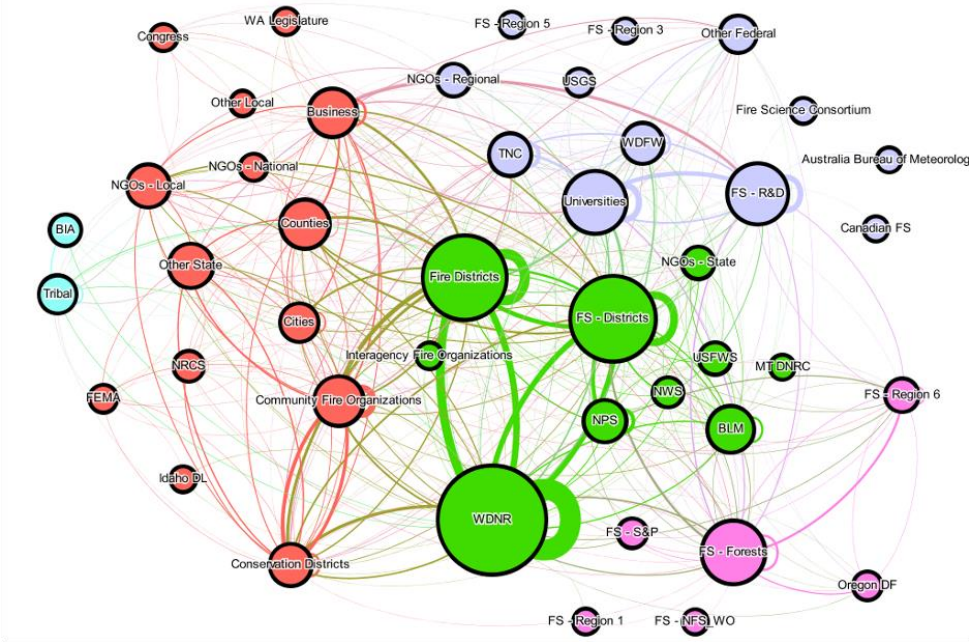


Figure 2.3. Wildfire risk management networks in northern Utah (top) and north central Washington (bottom). Ellipses in northern Utah's network highlight two clusters of organizations that Utah's Department of Natural Resources (DNR) connects. The top ellipse highlights mostly federal organizations whereas the bottom ellipse highlights mostly local organizations. Colors in north central Washington's network highlight multiple clusters of organizations arrayed around a central cluster dominated by a triangle of connections between staff from local fire districts, the Washington Department of Natural Resources, and district offices of the US Forest Service.

These findings suggest that place-based understandings of regional hotspots are critical to understanding the capacity of local, state, federal managers, and other stakeholders to address cross-boundary fire risks. Further, the findings suggest that development of cross-boundary leadership for wildfire risk management needs to be tailored to existing local capacities. Despite the unique regional differences in the networks, the findings from these two study areas also highlight the important role that state natural resources agencies can play in connecting local and federal capabilities. Although not reported here, additional network studies will examine whether the state consistently plays a unique connecting role or whether regional variability is more common.

Cross-Scale and Cross-Boundary Governance Team

The Cross-Scale and Cross-Boundary Governance Team's research focuses on factors promoting and limiting collaboration and co-management across scales and identifies investments and mechanisms that can improve cross-boundary wildfire governance so that mitigation work can be scaled up to landscape and fireshed scales. Scaling up mitigation requires effectively coordinating wildfire work across organizations, jurisdictions, landscapes, and regions.

1. Effective governance requires that state and federal agencies, tribes, and communities translate priorities and policy objectives across scales to create the alignment and synergies to scale up mitigation efforts. The Governance Team found that wildfire actors, from the local to national scales, identified the challenge of applying national policies and programs to the local scale as a major barrier to scaling up mitigation. Thus, national initiatives need to work more closely with organizations at the local and regional scales to translate these priorities into programs that are locally-appropriate. Further,

Governance Team research illustrates how systems that acknowledge that "leadership" is dynamic and shifting can better innovative to develop specific governance systems that respond to local goals and conditions.

2. Understanding the barriers to scaling up mitigation can identify the solutions and investments that will advance landscape-scale wildfire work. Governance research has revealed that there are a number of different ways of thinking about or "framing" these barriers, and each of these leads to different types of solutions. Conventional framings focus on lack of funding and capacity as key barriers. But many people who work on wildfire also emphasize the need to build capacity for agency-agency partnerships and for effectively engaging the public, through agency positions that focus on collaboration, through trainings on partnerships, and through personnel policies that reward working across organizational and jurisdictional boundaries. In particular, there is a need to build capacity within the agencies to work more effectively with communities, states, NGOs, and tribes.

3. While wildfire governance has focused on the need to be collaborative and adaptive, effective governance also requires navigating power imbalances, uncertainty, and trade-offs. The Governance Team applied work on transboundary, anticipatory, and risk governance to the wildfire problem to identify the lessons that can be learned from these fields. This analysis highlighted the need to address differences in political power and authority in collaborative efforts, the need to explicitly consider uncertainty about the future in mitigation work, and the need for mechanisms that enable dialogue about trade-offs between different strategies.

Summary and Integration

Taken as a whole, the work of the CoMFRT Partnership reflects an approach to study the social architecture at a variety of scales at which the cross-boundary nature of wildfire risk is managed (see Figure 1.1). CoMFRT represents a unique opportunity to gain insights within and across these nested scales in ways single studies are unable to complete. Working from the most local level, the WiRē team uses parcel-level observations and paired household survey data to provide insights into Individual-level (household) decisions and actions that shape wildfire risk on private residential properties. These social and parcel conditions, collectively shape the next larger scale of a community's collective risk and the pathways along which collective action may be pursued. These household level data reveal a great deal of diversity in levels and perceptions of risk and where and how households acquire and use fire risk information. They provide actionable insights that local fire authorities can use to customize programs that build greater resilience at the household and subdivision level. Understanding that diversity also contributes to the Community Pathways research, which shows significant differences in the cross-boundary wildfire mitigation actions that local collaborators can enact across diverse social and biophysical conditions. In other words, there appear to be distinct 'pathways' that diverse community leaders and fire professionals can use to implement wildfire management strategies at a community or landscape level. This work suggests that assessment tools are needed to help communities "customize" their strategies for building capacity and resilience to wildfire exposure in ways that are specific to their particular context as revealed by the household and pathways data.

Continuing to work upward or outward in scale, many local practitioners who work with fire-prone communities are connected to and participate in various wildfire-related practitioner networks. As demonstrated by the Social Network Team's research findings, particular individuals and organizations can have a significant impact on wildfire governance success at different scales. Social network mapping shows which organizations are engaged in addressing fire risk across the landscape and helps to identify boundary-spanning individuals who are especially helpful in connecting smaller groups of people into a

larger governance network. These networks function within a broader regulatory and policy context that potentially provides programs, tools, and resources to these networks. To better understand how these resources are being or can be deployed the Governance Team interviewed these boundary-spanners along with other identified members of the wildfire governance social network in North Central Washington. Findings from these interviews were consistent with other interviews with wildfire managers and policymakers at other governance scales. Specifically, participants discussed the importance of collaboration as a tool, but they warned that collaboration takes time and resources that many agencies and other stakeholders lack. These interviews also revealed a possible disconnect between the landscape-scale governance and the perspective of regional and/or national scale policymakers. Interviews at larger scales suggested that policymakers are more supportive of collaboration than many stakeholders perceive, but that policymakers struggle to turn national level programs into landscape scale directives.

Fieldwork in the two study sites highlight important lessons to support building fire adapted communities and surrounding landscapes to better live with wildland fire. Findings demonstrate that this cannot be achieved by primarily focusing on biophysical mitigation strategies (e.g., fuel treatments) independent of the social context of wildland fire exposure. By interconnecting our various team investigations within a multi-scale social system, the CoMFRT strategy can generate a more complete, understanding of the various social structures and associated functions of wildfire governance. Co-management of cross-boundary problems demands no less. We must understand the complex individual and cross-scalar social characteristics involved and recognize that collaboration is more than an agency sponsored venue for surfacing value and policy choices, it is a way to identify, integrate, and deploy diverse forms of knowledge as a form of shared or social learning, one that is inherently difficult for agencies of government to implement (Wyborn & Dovers, 2014).

Part 3. Recommendations and Next Steps

3.1 Project Recommendations

Recommendations for Forest Service Positions and Personnel

- Invest in new “liaison” positions that are tasked to work across jurisdictional and organizational boundaries and build partnerships to enable landscape-scale mitigation work.
- Add collaboration and partnerships to position descriptions and performance evaluations to incentivize these activities and hold personnel accountable for this work.
- Provide trainings on effective collaboration and partnerships, including how to build trust and relationships, and the specific policy and programmatic tools that can be used to work across jurisdictions and organizations.
- Develop mechanisms to reduce staff turnover to enhance continuity and ensure long-term investment in the relationships and partnerships that enable cross-boundary work. These might include revised career ladders and promotion systems.

Recommendations to Incentivize and Build Forest Service Capacity for Collaboration

- Establish metrics for assessing collaboration and partnerships at Region, Forest, and District-levels, including relationships and collaborative forums, as well as partnership projects that are implemented on the ground.

- Adjust expectations such that Forest Service staff and leadership recognize that investments in long-term collaborations, while time intensive, will pay off by eventually scaling up mitigation work and leading to projects that benefit multiple organizations and groups.
- Spend agency funds earmarked for fuels treatments on agreements with local institutions and NGOs to treat acres and increase collaborative capacity.

Recommendations for Build Capacity for Interagency Partnerships

- Recognize that working across organizations brings a broader set of resources to the table to enable larger-scale and landscape-scale mitigation work.
- Invest in processes that enable agencies to navigate across different missions and policy mandates, including through trainings and forums with policy experts and innovators. Ensure agency staff have the time and space to negotiate a shared understanding of the problem and to co-develop priorities and work plans across organizations.

Recommendations for Working with Tribes

- Hire tribal liaisons at all levels to build relationships with tribes to better understand indigenous perspectives on the role of cultural burning and indigenous fire knowledge in federal land management, and to develop partnerships to manage fire across boundaries with tribes (where there is tribal interest in such activities).
- Require line-officers and fire personnel to participate in trainings about tribal sovereignty, nation to nation consultation, cultural burning, and indigenous fire knowledge.
- Invest in new or existing tools that enable partnerships with tribes, including but not limited to Good Neighbor Authority and 638 Project Authority. Ask tribes what tools they would recommend.

Recommendations for Expanded Public Engagement and More Effective Collaboration

- Adopt deliberative processes used in risk governance that explicitly consider tradeoffs with a broad range of stakeholders, to build capacity for making decisions when win-win solutions are not available.
- Invest in early and pre-NEPA public engagement to enable deliberation and mutual learning so that wildfire mitigation proposals reflect broad public interests and values.
- Attend to differences in power and authority in the collaborative process first by engaging important but underserved stakeholders and by adopting policies and procedures that encourages their input.
- Invest in building collaborative capacity within and between a range of community, NGO, local, tribal, state, and federal agencies, prior to fire events and with a focus on scaling up mitigation work.

Recommendations for New or Expanded Policy, Planning, or Application Tools

- Explore policy mechanisms that can increase flexibility for agencies to work more efficiently and effectively across jurisdictional and organizational boundaries.
- Explore policy tools that help organizations and stakeholders at different scales build collective visions about wildfire risk and mitigation, tools that prioritize local input in the context of broader state, regional, or national goals, and provide guardrails for collaboration without prescribing particular actions.

- Consider how wildfire risk assessments can be utilized to provide both national consistency and flexibility to reflect local contexts and priorities.
- Utilize tools like scenario planning from anticipatory governance to integrate uncertainty about future conditions into the decision-making process, to build the ability to manage wildfire risk proactively in the face of uncertainty and change.
- Collaborative research that is engaging, participatory, and that seeks to directly benefit all participants (researchers and practitioners) generates relevant, actionable insights to inform local management needs while contributing to scholarship.
- Further develop guides, materials and processes that help key stakeholders work with diverse human populations across hotspots to uncover the characteristics of emergent communities and social fragmentation across hotspots.
- Create and institutionalize shared repositories of divergent "pathways" that professionals, residents, and planners can use to more quickly tailor adaptation to unique local context using expanding archetype classifications.
- Build feedback mechanisms and/or monitoring methodologies into fireshed repositories or the new 10-year wildfire strategy whereby local populations (including professionals) can monitor their progress toward fire adaptation or expand guides and processes articulated in points 1 and 2 as means to standardize data collection on fire adaptation progress.

3.2 Next Steps

Thus far, CoMFRT has pursued a largely research-focused agenda while noting a need to build in more application-oriented insights and outcomes. Moving forward over the next five years CoMFRT proposes to pursue two overlapping components:

A Research (Learning) Component: Add 3-5 additional research sites. The primary objective is to engage in iterative learning grounded in each study site guided by a co-production approach among researchers, practitioners, and decision makers throughout the research cycle.

A Practice (Applications) Component: The primary objective is to build and test a series of applications based on findings and recommendations developed in the Research/Learning components.

Priority tasks moving forward for each team are:

- *Community Pathways* will continue to examine how diverse sets of human populations across landscapes form (or do not form) the bonds, shared values, institutions, and processes of interaction that allow them to promote or modify collective action to build adaptation to wildfire. A key objective is to refine and test community capacity self-assessment tools to facilitate identification appropriate community pathways that are related to specific local needs. These tools would allow residents to identify and prioritize specific needs to better live with fire.

- *Social Networks* will continue to examine how professional stakeholders in wildfire risk management are organized to manage cross-boundary wildfire risk. Refine social network mapping protocols that identify actors in the social system, including those that are most prominent, underserved groups and others that might be missing from cross-boundary efforts to address wildfire risk. Identify regional level wildfire risk mitigation efforts and where mitigation activities have occurred on the landscape. Using network analysis (and potentially other team expertise), seek to understand how the knowledge and interests of

underrepresented groups are represented in local agency efforts to address wildfire risk and fuels management such as the Wildfire Risk to Communities and PODS.

- *Multi-Scale and Cross-Boundary Governance* – Governance will continue to examine the processes and institutions that support (or constrain) cross-scale and cross-boundary wildfire work, with a focus on identifying policies, programs, and organizational changes that can scale up wildfire risk mitigation. Develop social learning process for USFS Washington Office (WO) to reflect on WO interview findings and to develop recommendations based on those results. Develop governance tool that different actors can utilize at the landscape scale to better understand how to address barriers to scaling up mitigation across jurisdictional and organizational boundaries. Develop and test local stakeholder social learning tools, such as workshops and analog table-top games, scenario planning, and other simulated problem-solving approaches that will foster inter-stakeholder learning, capacity, and relationship building.

- *Social/community Vulnerability* is a newly formed team that will assess and characterize both the kinds and degrees of vulnerability (e.g., vulnerability archetypes) and identify the social and geographic forces that are producing vulnerabilities and their unequal distribution across society. Put another way, fire management programs need to be able to assess both *social equity* in program service delivery and differential *social vulnerabilities* to wildfire hazards. Apply and evaluate established methods for spatial social vulnerability analyses. Design protocols and conduct research tailored to each study site to "ground truth" commonly used social vulnerability indices and outputs that rely on secondary (e.g., Census) data to inform these assessments.

- *Co-Production and Integration* will conduct cross topic and cross study site integrated analyses (e.g., meta-analysis) to generate co-produced, integrated, and actionable recommendations to yield additional recommendations to build wildfire adapted communities. Review Forest Service analysis guiding the Forest Service investments and operations (e.g., Firesheds and PODs) and summarize the extent to which social science has and/or could be more fully integrated into the management actions guided by that analysis. Co-produce actionable findings and recommendations with wildfire managers working at a variety of scales. Convene co-production workshops of both researchers and managers to identify lessons learned and integrated recommendations for future efforts to support wildfire adaptation.

4.0. Conclusions

The Co-management of Fire Risk Transmission (CoMFRT) partnership is a unique effort funded by the USDA Forest Service (USFS), Fire and Aviation Management (FAM) to explore the establishment of a long-term social science research program on community capacity to address cross-boundary wildfire risk in fire-prone areas that could inform USFS wildfire risk related programs and investments. CoMFRT was established to go beyond "one-off" studies by creating a coordinated multi-scaled, interdisciplinary, longitudinal applied research program. The research conducted this far has highlighted the innovative nature of this effort and the opportunities it presents for the Forest Service and other agencies and organizations in the wildfire management system to improve outcomes by building place-specific (socially legitimate and relevant) co-produced social science knowledge to support collaborative cross-boundary, multi-scale co-management of wildfire risk and exposure. Finally, as priorities change and learning advances, it will be prudent to engage in regular review and subsequent research planning process to reflect on lessons learned and direct CoMFRT toward ongoing and emerging research needs

and social science-based tools to improve cross-boundary wildfire risk governance and building resilience to wildfire.

In conclusion, some key take-away lessons from our work thus far are:

1. It is essential to understand and map the social diversity that exists within and across fire-prone landscapes and communities and understand how this diversity relates to reaching desired conditions (e.g., more wildfire adapted communities).
2. Agencies need better ways to diagnose social conditions and management needs and capacities as they exist in specific places at specific local levels. This will allow us to better identify effective pathways to improve fire adaptation and resilience suited to the particular social conditions of fire-prone landscapes and the different opportunities and challenges at multiple scales, from households and neighborhoods to larger collections of communities that are interconnected by fire risk exposure.
3. Too often managing authorities try to deal with social complexity using generalizable, predictive models or tools that focus on minimizing loss of narrowly defined but easily measured values at risk (e. g., dwellings, water quality) in leu of case sensitive diagnostic tools that incorporate and account for the diversity of local interests and capacities as they relate to building adaptation (Essen et al. 2021). Achieving fire adaptation at the local level is more akin to applying practice-based knowledge (Williams, 2017); that is, knowledge acquired through case specific practice (as is often the situation in medicine, business, education, and law) and the development of a communities of practice engaged in collaborative in a given landscape (Collins, 2014; Wegner, 1998).
4. Cross-boundary or cross-jurisdictional fire risk mitigation requires the cultivation of interpersonal relationships, trust, and a sense of shared fate. Any approach that relies primarily on technical knowledge, expertise and inputs developed from afar are less likely to be trusted than information and knowledge cultivated locally. Instead, an inclusive and just approach to building community adaptation to wildfire values local expertise and locally generated knowledge including but not limited to Indigenous Traditional Knowledge and local, practice-based knowledge.
5. In following a context specific, practice-based practice model that incorporates locally knowledge and expertise, the Forest Service role would focus more strongly on helping local fire mitigation professionals do their jobs by providing information, training, and data gathering on the effectiveness of many locally directed efforts at a that then can be used to adjust and improve practice in an ongoing learning process.
6. There is a mismatch between expertise needed to build fire adapted communities and current professional staff in many state and federal agencies involved in fire risk mitigation. Recognizing local differences and the importance of local, practice-based knowledge benefits from high level personnel and programmatic investments in a workforce inside and outside natural resource management agencies that reflect the social nature of the problem. This might involve, for example, building an extension program that is primarily informed by social science (e.g., modeled after NCRS and/or the land grant university extension service) to strengthen practitioner networks, cultivate practice-based knowledge communities, and support building fire adapted communities

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