

FINAL REPORT

Fire-Adapted Communities on the Range:
Alternative Models of Wildfire Response

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List of Abbreviations / Acronyms

BLM: Bureau of Land Management
IDL: Idaho Department of Lands
MOU: Memorandum of Understanding
ODF: Oregon Department of Forestry
RFPA: Rangeland Fire Protection Association
UO: University of Oregon

Keywords

Rangeland Fire Protection Associations, rangelands, wildfire suppression, Bureau of Land Management, Idaho, Oregon

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Abstract

Growing and widespread concern regarding the social and ecological impacts of wildfire has sparked multiple innovations in planning, preparation, and management. Among these innovations are new models of coproduction in which government fire managers collaborate with non-governmental entities on wildfire response. The most prominent of these innovations in rangeland landscapes is the Rangeland Fire Protection Association model, currently authorized in the states of Idaho, Nevada, and Oregon. Under each respective state's Rangeland Fire Protection Association model, associations composed of volunteer wildland firefighters (primarily ranchers or those from ranching families) in remote rangeland landscapes are provided with the resources, training, and authority to respond to wildfires on private and state lands within their jurisdictions. Through cooperative agreements, these associations can also receive authorization to respond on the abundant federal (largely Bureau of Land Management) lands within their jurisdictions. Although Rangeland Fire Protection Association programs have been in place in Oregon since the 1960s, in Idaho since 2013, and in Nevada since 2015, there has been very little research on how they interact with state and federal partners, how state program design can affect outcomes, or on the opportunities and challenges created by this model. Given the extensive literature on institutional design for sustainable resource management, the study of Rangeland Fire Protection Associations provided an opportunity to understand how institutional design within a multi-level governance structure influences fire management outcomes. Our research project set out to develop some of the first research findings of any kind on Rangeland Fire Protection Associations. We did so through a comparative case study research design, including two associations in Oregon and two in Idaho. Included in these case studies were participatory mapping exercises, in which we asked both volunteer association members and Bureau of Land Management fire managers to designate values and risks on the landscape through the use of points and lines on paper maps. Our research objectives were to: 1) analyze the effectiveness of the Rangeland Fire Protection Association model; 2) analyze the alignment of capabilities and values at risk across rural landscapes; and 3) develop conceptual models and generate hypotheses about the role of community-based fire response organizations in encouraging fire-adapted communities. In addition, our outreach objective was to disseminate our results to diverse academic and practitioner audiences. We successfully completed case studies and associated participatory mapping exercises with the Jordan Valley and Crane associations in Oregon and with the Mountain Home and Owyhee associations in Idaho. Combined with an analysis of their respective state programs, this research provided insights into the evolving relationships between volunteer firefighters, Bureau of Land Management fire professionals, and state-level intermediaries and highlighted the specific assets that volunteers were able to contribute under the aegis of their respective state programs. Our research also highlighted specific points of tension, particularly regarding the sometimes uneasy integration of highly formalized federal institutions and less formal local institutions, and pointed to the importance of state policy design and implementation in exacerbating or ameliorating these tensions. These results were shared broadly both with practitioners across the West and with academics and researchers through a series of in-person and web-based presentations along with printed and online resources. We solicited feedback from association volunteers and from state and federal experts throughout the research process, increasing confidence in the validity of our results.

Objectives

This project included three research objectives with hypotheses, and one outreach objective. All objectives were met through the study.

1) *Analyze the RFPA model's effectiveness.* Hypothesis: RFPAs provide community-based wildfire response capacity, but as they are emergent and devolved organizations, they also present distinct challenges and uncertainties in safety, coordination, and integration with formalized fire suppression agencies.

2) *Analyze the alignment of capacities and values at risk across rural landscapes.* Hypothesis: There is spatial

variation in response capacity as well as variation between RFPAs and agency understandings of risks, values, and capacities.

3) *Develop conceptual models and new hypotheses about the role of community-based fire response organizations in encouraging fire-adapted communities.* Hypothesis: Community-based fire management models such as RFPAs facilitate local pre-fire preparedness, fire response, and post-fire recovery capacity.

4) *Disseminate results to diverse audiences to improve management.*

The linkages of this research to the applicable task statement under which it was submitted included: 1) stronger understanding of a growing innovation in community-based wildfire response in the rural West; 2) increased coordination and shared prioritization among RFPAs and suppression agencies in our study areas; and 3) new conceptual models and hypotheses about how local organizations linked to multi-scaled suppression networks may promote fire-adapted communities in rural contexts.

Background

Rangelands in the American West have experienced increased frequency of wildfire over the past several decades (U.S. Department of the Interior, 2015). Several recent rangeland wildfires have exceeded 100,000 acres in size; for example, the Long Draw fire of 2012 in southeastern Oregon burned 557,648 acres before it was contained. These fire events threaten working rangelands for cattle production, habitat for species such as the greater sage-grouse and ungulates, and other values such as recreation and the western culture of the region. Growing concern over this situation was elevated by the potential listing of the greater sage-grouse under the federal Endangered Species Act due to in part to destruction of its habitat by large wildfires and other factors. But effective response to these fires can pose challenges. The Bureau of Land Management (BLM) provides fire protection for a large proportion of these mixed-ownership landscapes, and its response capacity is typically centralized in or near communities, which can be far from where rangeland fires start. Depending on the fire season, many resources may be already allocated to other incidents around the nation. Further, a pattern of ranchers' unauthorized involvement in fire response on federal lands as they sought to defend forage and cattle resulted in conflict with BLM personnel. In this context, a new model for rangeland wildfire protection has emerged to address these issues. Rangeland Fire Protection Associations (RFPAs) emerged across Oregon and Idaho as volunteer non-profit groups of landowners trained and authorized to respond to wildfires that start within their typically mixed ownership districts (Stasiewicz and Paveglio, 2017). RFA members receive training and equipment from state or federal partners and are authorized to respond to wildland fires on private and state lands within their districts. They typically also enter into agreements with the BLM to provide wildfire protection on federal rangelands as well. Although one RFA existed in Oregon in the 1960s, their growth across the southeastern portion of the state and proliferation of the model in Idaho has been more recent. At the time of our proposal, there was no existing study of RFPAs; since that time, Stasiewicz and Paveglio (2017) have produced research on RFPAs in Idaho.

RFPAs represent an innovation in community-based wildfire response that is relevant to scientific, practitioner, and policy audiences. First, there is broad interest in community preparedness and adaptation to wildfire. The National Cohesive Wildfire Strategy includes extensive focus on fire-adapted communities. But the role of local residents is largely to prepare for and evacuate during fire events, while emergency responders and government agencies manage response (Wolshon and Marchive, 2007). Other approaches such as shelter in place, stay-and-defend, and community-based suppression organizations are being attempted, largely outside of the U.S. and in remote landscapes (e.g., bushlands in Australia). Research on these models in developed world contexts is currently limited. In the western U.S., scholars increasingly recognize that rural "working lands" communities have interest in participating in fire suppression efforts, and may contribute valuable assets including local knowledge, social networks, equipment, or active roles on the fireline (Paveglio et al., 2015a, 2015b). But challenges to safety, communication, and effective partnerships are also likely to arise when nonprofessional, non-

government entities engage in suppression with professionalized federal and state agencies. More research was needed to explore models of community-based wildfire response for those reasons. Second, RFPAs are a novel adaptation in rangeland fire management that warranted attention in the 2015 Interior Secretarial Order 3366 and Integrated Rangeland Fire Management Strategy. The latter directly stated that “increasing the training, coordination, and technical assistance for local/rural fire departments and RFPAs is essential to provide local protection and offers another way of extending suppression assets and ensuring that we have as many trained ‘boots on the ground’ for initial attack as possible.” They have also garnered support from both state and federal governments as a frontline strategy in protection of greater sage-grouse habitat. Research on RFPAs helps support these larger rangeland policy and manager needs, while also broadening the scope of wildfire social science. Wildfire social science has largely examined themes of communities and fire through studies of forested wildland-urban interfaces, and emphasized public perceptions, preferences, and preparedness (McCaffrey et al., 2013). The agency most commonly engaged in this setting is the US Forest Service. Research about RFPAs incorporates new understandings of rangeland communities, active roles in suppression, and the BLM into that existing corpus.

Materials and Methods

Research protocols were approved by the University of Oregon’s Institutional Review Board for compliance with human subjects research requirements (protocol number 06062014.010).

The context in which RFPAs are found (rural and remote rangeland communities) and lack of existing research on the topic led to a primarily exploratory study design. We conducted qualitative, inductive case studies (Yin, 2009). This method is appropriate given the low population density, lack of community-scale secondary data, and often-insular culture of ranching communities; these factors limit the insights available through other methods such as mail surveys (Sayre, 2004). Researcher access to ranchers can be challenging, and often relies on “gatekeepers” and time spent building in-depth contextual understanding of the communities under study.

Data collection:

1. Document analysis: we gathered available documentation on RFPAs including state and federal laws and policies, RFA organizational documents, spatial files, and reports and media about recent large fires in which RFPAs were involved.
2. Qualitative interview-based case studies: We designed a qualitative interview process used to conduct four case studies of RFPAs and their respective state programs. Two case study RFPAs were in Oregon (Crane and Jordan Valley) and two in Idaho (Owyhee and Mountain Home) (Figure 1). The Nevada program was developed after our research began, and our interest was in studying associations with prior experience with wildfire. Case study selection was purposively focused on RFPAs with longer histories, larger landscapes, and relatively recent experience with large fires. We conducted interviews with active RFA members and BLM fire managers in each area, asking questions about their history, experience with fires, relationships with federal fire managers, and development over time. We also interviewed state and federal managers who worked with RFPAs in each state. We interviewed a total of 69 participants through 63 interviews.
3. Human ecology mapping: We asked RFA members and BLM managers that work directly with RFPAs in each case study to indicate values and risks across their respective landscapes by marking up a series of paper maps (McLain et al., 2013) and completing a worksheet (Figure 2). Prompts focused on individuals’ areas of response, areas where they felt that fire could be beneficial/destructive, and values of importance to individuals and the community.



Figure 1. Location of case study areas in Oregon and Idaho



Figure 2. Interviewee participating in human ecology mapping exercise

Analysis:

Interview audio files were transcribed verbatim. We analyzed document and interview data using NVivo, an established qualitative analysis software program. Four transcripts were pilot coded by three members of the research team and compared to assure inter-coder reliability. Then, all transcripts were coded using a guide of 12 predetermined codes that we drew from our research questions, goals raised by BLM/ODF/IDL, and some

existing literature. These allowed us to identify data relevant to different aspects of the RFPFA model, including their organizational arrangements, structures, roles and authorities (and interpretations thereof), and interactions with BLM personnel. Open codes that emerged from the data were also created (Corbin and Strauss, 2008). We identified causal conditions, processes, and outcomes seen in the data, and used a series of propositions about how RFPAs functioned similarly and differently between cases as well as each set of cases by states (Ryan and Bernard, 2003). Paper maps and worksheets were digitized, synthesized, and analyzed by UO InfoGraphics Lab using Esri ArcGIS software and Excel. Maps depicting response were created in each case for a total of 44 maps. Density kernel maps were produced, showing where values at risk tended to cluster in each case. We presented preliminary results at two state-level RFPFA meetings in each state, obtaining “member check” feedback from ranchers and agencies.

Results and Discussion

As noted previously, this project represented some of the first research conducted to date on RFPAs; what follows are the results of an exploratory study that attempted to inductively generate understandings of processes, relationships, and outcomes. These should be seen as preliminary findings that can be developed and tested through future research.

1. The Rangeland Fire Protection Association model presents opportunities to leverage the motivations, skills, and knowledge of ranchers to inform more effective fire response and create opportunities for learning and adaptation. At the same time, this model of “coproduction” presents challenges to the integration of formal and informal institutions, which is an enduring theme in environmental governance.

Ranchers possess important advantages for fire response that can be put into practice through the RFPFA model. These include in-depth local knowledge, access to their own resources and equipment, their spatial distribution across large landscapes, and strong motivation to protect their and their neighbors’ properties from fire. These assets aid in their ability to respond quickly, keeping fires small and preventing the numerous, spatially extensive impacts that can occur with larger events. Formalizing rancher capacity through the RFPFA model has allowed for more systematic application of their assets to wildfire response. The model’s features include nonprofit association status, liability insurance, state statutory authority, and agreements/MOUs with federal agencies. In some, but not all cases, this has reduced historic conflict over participation in suppression with the BLM as well. However, differences between the structures, goals, and cultures of BLM fire suppression and rancher communities remain. As a model of coproduction between federal managers and local users (Brandson and Honingh, 2016), RFPAs exemplify tensions between flexibility and accountability and challenges of institutional integration that are common to many multi-level environmental governance contexts. They may serve as promising avenues for integrating local institutions into formal environmental management programs, but show less promise as means for local actors to modify existing formal institutions to achieve better social and ecological fit. Relatively high-capacity federal bureaucracies may present challenges to creative local-scale wildfire response strategies, even in remote landscapes. Yet despite this limitation, the incorporation of local knowledge, skills, and institutions into a formal resource management framework appears to hold promise as a means to foster more adaptive community relationships with wildfire (Figure 3).

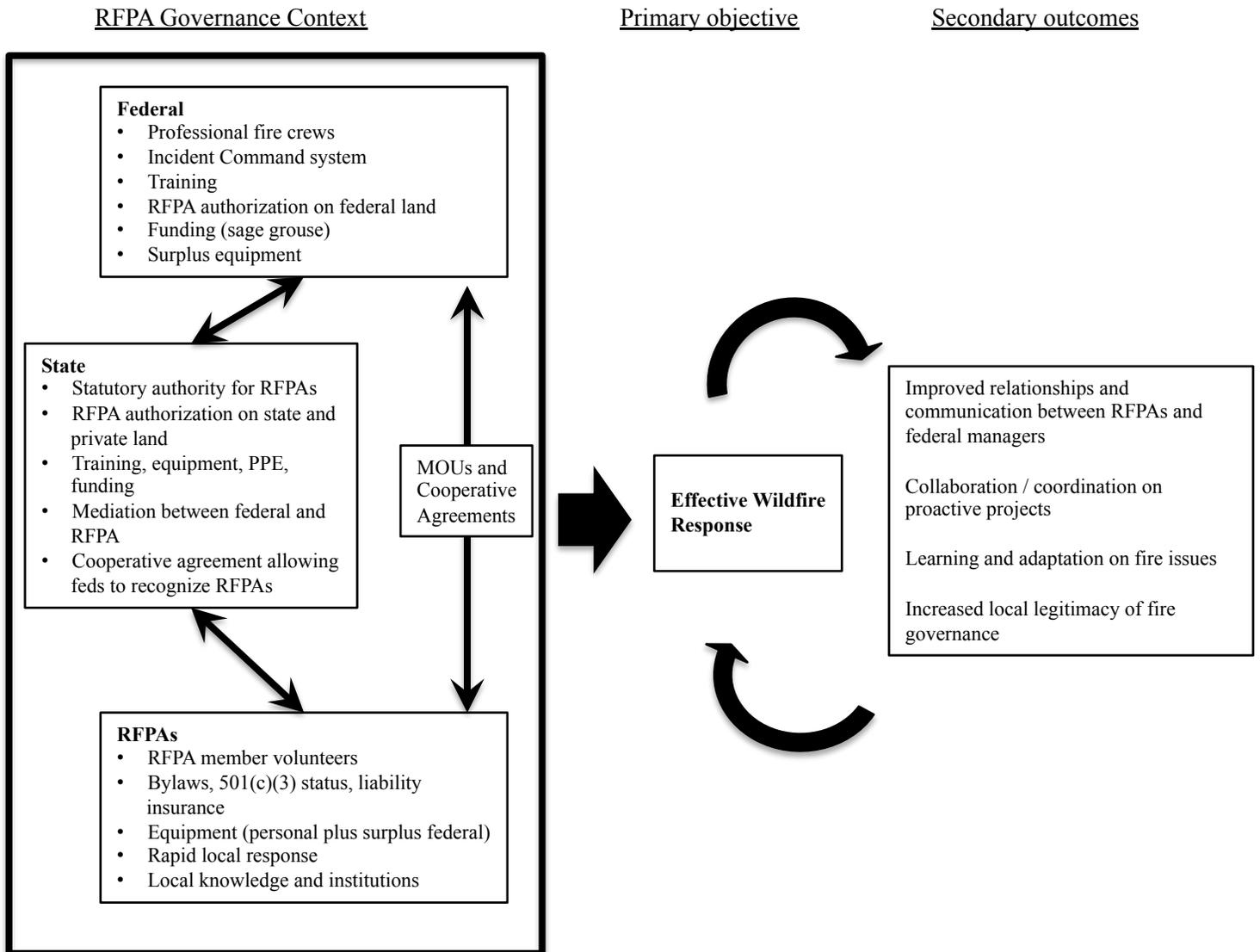


Figure 3. A conceptual model of the functioning of RFPAs for more effective wildfire response

2. Small structural differences in RFPAs programs in Oregon versus Idaho led to potentially important distinctions in agency-resource user relationships and program outcomes. The RFPAs experience suggests that state policy design can strongly shape the evolution of intergovernmental and agency-community dynamics and that RFPAs are a type of bottom-up cooperative federalism in which state governments may assert some autonomy in how federal lands within their boundaries are managed.

We found that the fundamental design of RFPAs programs at the state level structured expectations and relationships. RFPAs receive their statutory authority to respond to fires from state government. However, the implementation of the programs differed in each state for several reasons. First, differences in statutory basis underpinned each program. RFPAs statutes in Oregon are legally based on a private property owner’s right to defend their property from wildfire. The Idaho model is instead built upon the concept of ranchers being allowed to participate in fire suppression with federal managers. Second, there were different arrangements with federal agencies in each state. In Idaho, cooperating agreements with the BLM established shared rules and standards, and helped address concerns such as BLM liability for ranchers participating in their suppression efforts. In Oregon, these relationships were articulated through a different model—Memoranda of Understanding (MOU) between

the agency and each RFPA. Although the MOUs contained some similar rules for RFPA involvement (e.g., limiting their participation to initial attack), they did not specify that RFPAs would follow all federal standards. Oregon state standards for personal protective equipment, for example, were used instead. Third, the state agencies managing the RFPA programs took different roles. In Idaho, IDL has tended to help ensure RFPA compliance with BLM requirements whereas in Oregon, ODF has historically advocated for RFPA members in their use of state rather than federal standards. As a result, we found that many Oregon RFPA members perceived a right to defensible property interests on federal lands (such as cattle, fencing, and forage), regardless of requirements for federal fire cooperators. In general, Idaho RFPA members saw their roles as more limited to early stages of initial attack in their local areas, whereas Oregon members took a more temporally and spatially expansive approach that at times caused conflict. Practically, other states that are developing RFPA programs may wish to consider the implications of statutory basis and program design on potential outcomes.

3. The RFPA model demonstrates a type of emergency response organization with hybrid emergent and established characteristics. RFPAs were organized through formal structures, but emergence manifested in the unpredictability of fire events and response behaviors. This example suggests that more attention to the intersection of established organizations and emergent actors/behaviors in disaster response is warranted. The interactional implications of repetitive disaster events for the repeat emergent organizations that respond should also be examined.

Applying concepts from emergency response research, we found that RFPAs demonstrated a hybridity of established and emergent characteristics somewhat similar to a “repeat emergent organization” model (Carlton and Mills, 2017) (Table 1). First, we found that RFPAs drew on established institutions including formalized structures of their own (nonprofit associations), coordination with a centralized fire response system (BLM fire managers), and longstanding social relationships and shared values; rather than the entirely unplanned, novel arrangements and “swift trust” that characterize traditional definitions of emergence in disaster response. But emergence was present in the environment (unpredictability of fire events) and in behaviors (of some RFPA members, particularly in Oregon). Our studied RFPAs appeared to face tensions between established and emergent characteristics. The primary explanatory variable for differences across cases was the state context. The statutory bases and influence of state program leadership led to rather different interpretations of RFPAs’ roles in Oregon and Idaho, as also noted in primary finding #2. Second, we found that the “repeat” nature of wildfires had several implications for the efficacy of the RFPA model. Repeated events and experience allowed RFPAs and their BLM partners to develop and evolve their capacities. Trainings and time spent together in the offseason appeared to help foster better relationships, mutual understanding, and increased skills. This demonstrates how different actors may be able to develop appreciation and understanding of each others’ values and find means to balance them in the response effort. However, repeated experiences wherein the RFPA members and BLM did not appear to understand or support others’ interests had the effect of establishing and reinforcing some negative interactions and perceptions.

Dimension	RFPAs
Participation and membership	<ul style="list-style-type: none"> • Typically landowners with private ranches and grazing allotments • Membership based on location and dues paid to RFPA • Relationships usually exist long before and after fire events • Receive formal training and expertise • Represent their and other landowners' interests • Participation in each fire event dependent on its timing, location, proximity
Leadership	<ul style="list-style-type: none"> • Dependent on timing, location, and proximity of each fire event; but a subset are typically repeated leaders • Use of incident command structure with BLM
Organizational structures	<ul style="list-style-type: none"> • Structure, roles, and responsibilities are defined ex ante. • Interpretations of roles and authorities varied by state
Equipment and resources	<ul style="list-style-type: none"> • Have dedicated equipment and resources for response, although deployment is dependent on location of fire event and geographic extent to which members respond
Geographic centrality or dispersion	<ul style="list-style-type: none"> • Can demonstrate geographic dispersion and remote, independent groupings depending on extent and number of fire events
Activities and coordination	<ul style="list-style-type: none"> • Largely stable task definitions with flexible task assignments depending on fire event

Table 1. Summary of emergent and established qualities of the RFPA model in Oregon and Idaho

4. Human ecology mapping results

We used human ecology mapping, a relatively new method primarily used in public input settings (McLain et al., 2017), to examine if there was spatial variation in response capacity and variation between RFPA and agency understandings of risks, values, and capacities. Given the relatively small numbers of agency participants in our study, statistical or spatial analysis that compared agency to RFPA responses was not feasible. Mapping exercises and data affirmed that ranchers' response capacity is far more distributed across the landscape than that of the BLM. We also found that multiple values important to protect from fire for most participants included homes, ranching infrastructure, historical landmarks, and favorite recreation locations, which tended to cluster in certain areas (Figure 4). But many also suggested that everyone's property and resources were important, and that they would not choose one particular location or value over others. This suggested that the RFPA motto of "Neighbors Helping Neighbors" is embodied in many members.

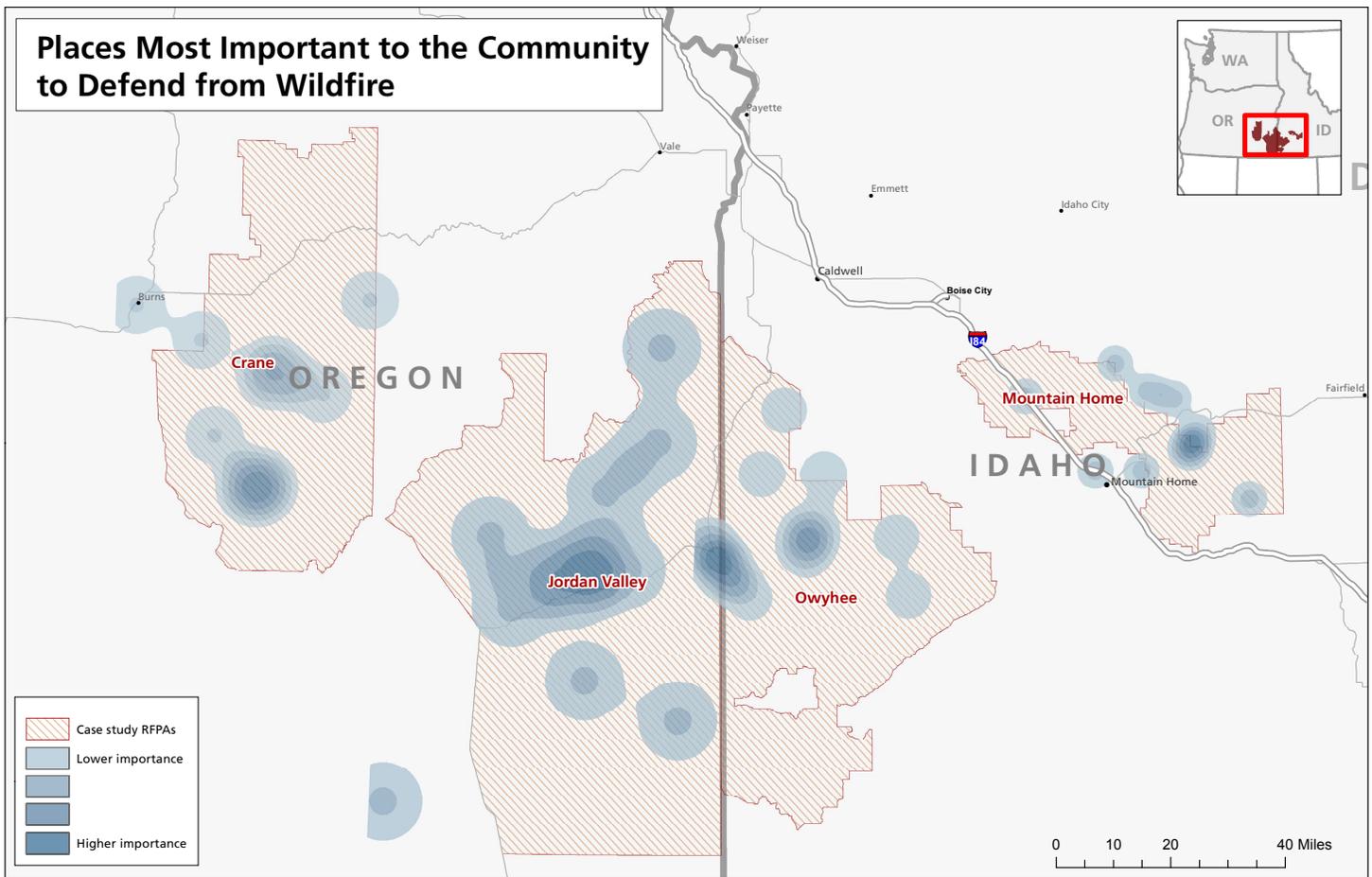


Figure 4. Locations of values most important to protect from wildfires

Although the density mapping of results showed a fairly high degree of agreement about community values at risk, there were differing perspectives on about when and where fire was desirable on the landscape, and where it posed risks (Figure 5). There was also overlap between areas where fire was at risk of being out of control yet perceived as beneficial to the landscape. This suggests potential challenges in managing suppression operations and use of fire successfully.

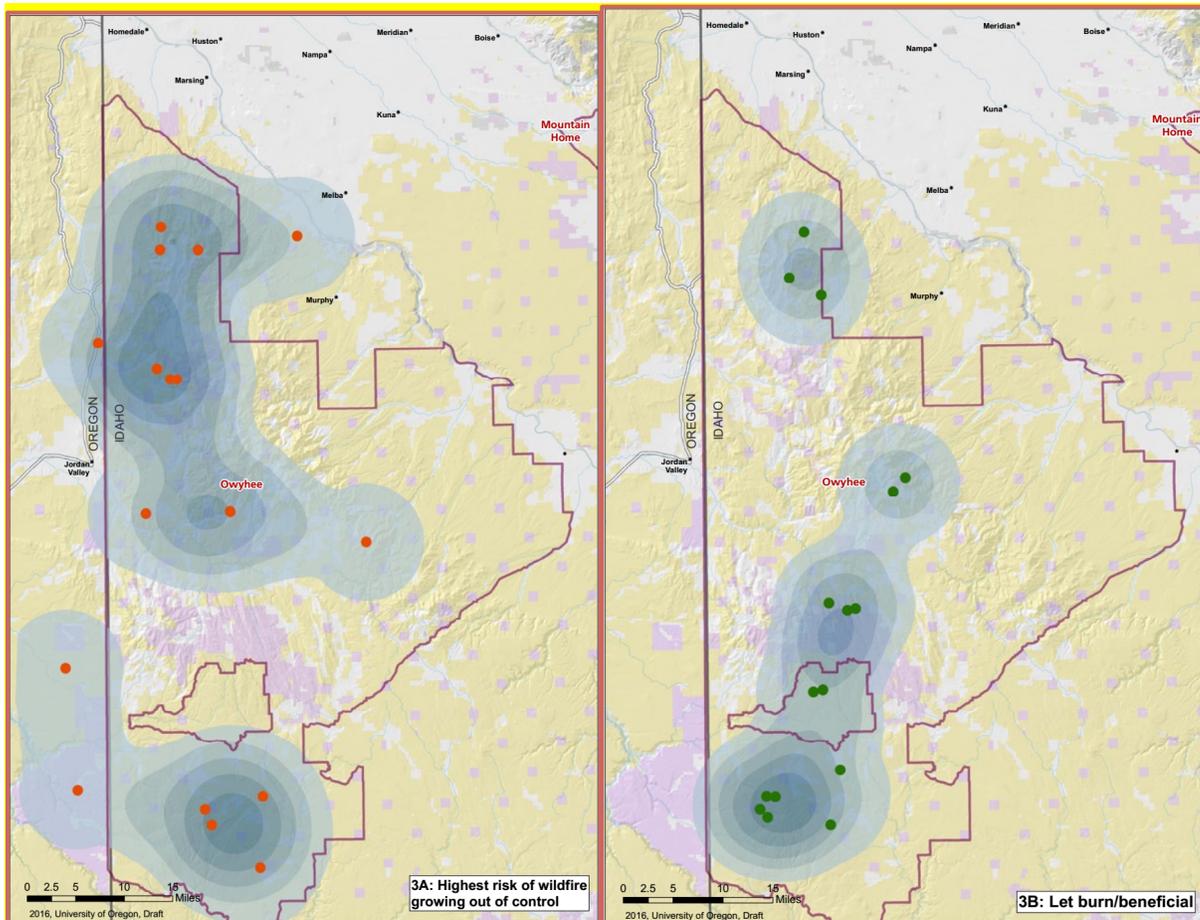


Figure 5. Human ecology map of perceived fire risks, Owyhee RFPA

Implications and Relevance

Implications for fire-adapted communities:

1. Some communities and residents may be motivated and able to play more substantive roles in fire governance than currently practiced through prevailing approaches in the United States.

Wildland fire suppression is typically an expert-led and government-led endeavor. Community residents are normally expected to make their immediate environment “fire-safe” and evacuate as needed; and residents and other stakeholders may also help prepare for fire by collaborating on planned fuels reduction and forest health projects in their local area. Yet some communities have experienced a sense of disempowerment and distress during wildfire experiences as a result of their inability to play a more substantive role (Davis et al., 2014). The existence and outcomes of RFPAs demonstrate that some rural residents may desire and be able to offer more active roles in both fire preparation and response under certain conditions, such as in “working lands” communities, which are characterized by long term/multigenerational inhabitation and an economic and cultural attachment to traditional natural resource livelihoods (Paveglio et al., 2015b). However, increased inclusion of non-professional entities in suppression would require several steps. One would be addressing safety, liability, interfaces with agency and contractor fire personnel, and organizational structures through which participation could be legally and operationally feasible. Another would be fostering learning and adaptation in order to ease the tensions between volunteer/informal and professional/formal institutions. Experience, repeated interactions, and being given responsibility may help local participants gain broader understanding of the justification for

professional firefighting techniques, and in turn increase professional comfort with and regard for local knowledge and values if there are appropriate conditions that encourage mutual learning and understanding.

2. There is some interest in RFPA engagement in fire adaptation activities beyond suppression.

Several RFPA member interviewees in both states indicated interest in participating in pre-fire mitigation measures such as fuel breaks and prescribed burns. They view wildfire on the range holistically, and are eager to prevent and constructively apply fire as well as respond to it. The RFPA infrastructure (nonprofit association, liability insurance, agreements) offers a potential vehicle for partnerships with governments on these other activities. Some members of the Mountain Home RFPA have already participated in a fuel break project, and several others in Oregon have participated in prescribed burns on private and state lands. Barriers to increased RFPA engagement in mitigation on federal land that would need to be considered include the length and requirements of agency planning processes, and more extensive training and certification required for participation in prescribed fire. In addition, some RFPA members view potential expansion of their roles as complicated and do not wish to extend the RFPA model to other activities.

Implications for community-agency collaboration:

1. RFPA-BLM relationships were improved through several means, which may be applicable to other agency-community relationships around suppression.

Experience and time spent together helped increase knowledge about wildfire behavior and suppression. RFPA members increased their understanding of how and why federal fire managers make decisions, and BLM personnel described increased respect for RFPA members' local knowledge and skills. Specific activities that may enhance this understanding include ride-alongs and working side-by-side during fire events; time spent together off the fireline during trainings, meetings, social events, and in the community; awareness of the lasting impact that single events or incidents can have positively and negatively on trust; collective after-action review for collective processing and learning; BLM staff serving as liaisons when non-local incident management teams come in; and transition memos and time getting acquainted for new BLM staff to provide institutional memory and introduction to RFPAs. Our cases also illustrated the necessity of allowing time and space for informal and interpersonal communications and relationships. Strong, collaborative-oriented leadership from each RFPA (e.g., chairperson, board, or others) can set the tone for positive relationships within the RFPA and with the BLM.

2. Program design and state agency roles can shape outcomes.

The statutory basis and design of RFPA programs at the state level structure participants' expectations and relationships with the BLM. States that are currently developing their own RFPA program or are considering adjusting an existing program may carefully consider which roles are best-suited to their context, and what relationship they may most productively have relative to and between RFPAs and the BLM. Roles may include mediator, advocate for RFPA needs, guarantor of federal standard compliance, grantor, convener, pass-through, and/or program manager.

Science Delivery Activities

We value science delivery greatly; PI Davis is a specialist in the Extension Service and co-PI Abrams is a faculty member of the Ecosystem Workforce Program, a longstanding applied research organization focused on policy and practitioner relevance. Ongoing engagement with managers and practitioners was therefore a central component of our project from start to finish. We originated our study proposal and research questions through consultation with ODF, IDL, and RFPA members to ensure its applicability to their current needs. We then strove to 1) share the project's goals and initial results throughout rather than solely at the end, 2) use diverse formats,

and 3) reach and interact with diverse audiences. We provided invited and accepted presentations at academic conferences and state-level annual meetings of RFPAs, within academic institutions including seminars and courses, and to the larger fire science community in the West. We also developed products accessible to managers, practitioners, and policy makers, which included a website, story map web application, technical report, briefing paper, and research brief. All were in clear language and focused on management and policy implications. Our story map application was designed to help share information about RFPAs in an interactive format that focused on their importance, organization, and challenges in order to better inform current policy interest in this model (Figure 6). Supportive partnerships with the Northwest Fire Science Consortium and Great Basin Fire Science Exchange enabled us to host a project website, deliver two webinars, and produce a research brief that reached the broad audiences of these organizations. Our three scientific manuscripts targeted different academic fields and areas of study including human ecology, policy, and disaster response. Importantly, we provided participating RFPAs, state agencies, and the BLM with paper copies of our technical report and briefing paper; and used a project mailing list and our networks to increase awareness of our website, which offers access to all products.

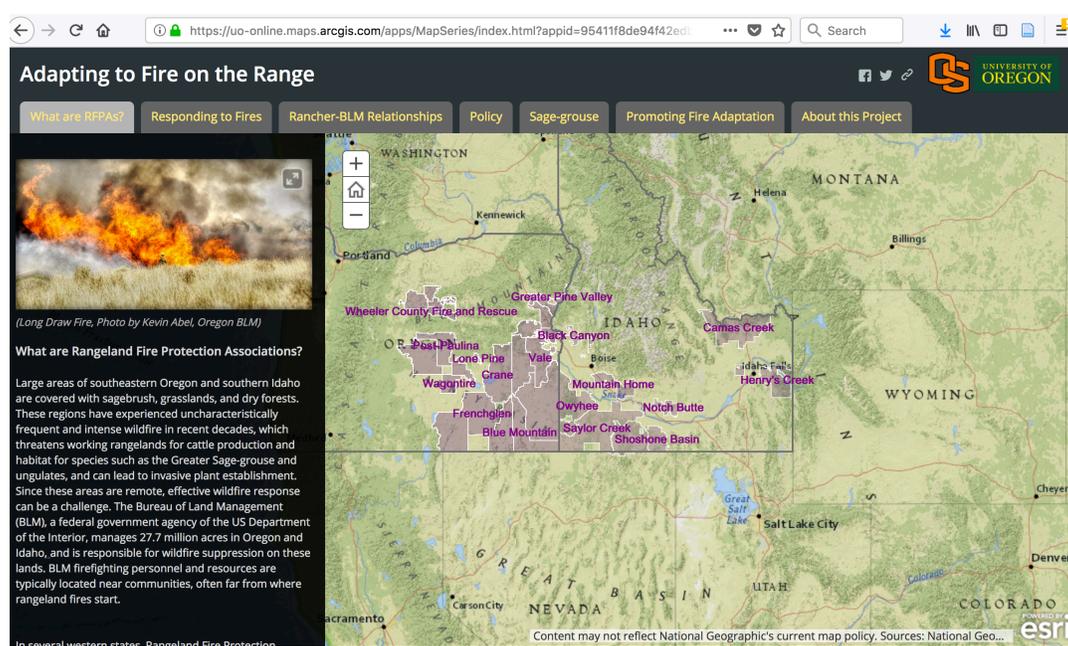


Figure 6. Screenshot of a tab of an Esri story map web application

Conclusions (Key Findings) and Implications for Management/Policy and Future Research

Our research documented 1) how RFPAs are structured in Oregon and Idaho, including legal, administrative, and organizational arrangements that supported them, 2) the opportunities and challenges of the model in each state, and 3) circumstances under which RFPAs- BLM partnerships were enhanced or challenged. First, we found that the RFPAs model (nonprofit status, liability insurance, and agreements) successfully harnessed the numerous advantages of local ranchers for more effective fire suppression across landownerships while addressing many historical challenges and barriers to their participation. Formalizing and authorizing ranchers' roles on the fireline largely clarified liability and responsibility concerns, and provided a venue for increased local capacity through trainings and equipment provision. However, differing interpretations of RFPAs authority and roles in Oregon and Idaho meant that the RFPAs- BLM relationship retained some conflict and confusion in the case of the former. Our research addressed our first hypothesis and objective, which was that RFPAs provide community-based wildfire response capacity, but as they are emergent and devolved organizations, they also present distinct challenges and uncertainties in safety, coordination, and integration with formalized

fire suppression agencies. Second, we used human ecology mapping, a relatively new method, to examine if there was spatial variation in response capacity as well as variation between RFPAs and agency understandings of risks, values, and capacities. Density mapping of results showed a fairly high degree of agreement about community values at risk, but differing perspectives about when and where fire was desirable or where it posed risks, which met our second objective. Third, we found that RFPAs are active primarily in fire response, but have growing interest in local pre-fire preparedness if barriers to expanded roles could be overcome. Finally, we used ongoing, interactive science delivery practices in multiple formats to respond to the broad interest in our research and results. RFPAs, BLM, state agencies, and others appreciated the relevance of this project to their current work, and the extent of our outreach and engagement efforts. Our research objectives were thus successfully met, and this project contributed to a better understanding of both the institutional design features of shared wildfire governance among researchers and the practical opportunities and challenges of the RFPAs model to help inform program and policy design among practitioners.

Summarized implications for management and policy

This project contributed new knowledge about a model of community-based fire management that is growing in popularity and increasingly viewed as a crucial, front-line strategy for protecting sage-grouse habitat and the ranching industry (e.g., in state-level sage-grouse conservation efforts and the 2015 Integrated Rangeland Fire Management Strategy). We successfully helped characterize and identify the strengths and weaknesses of the RFPAs model such that existing programs may be improved and future programs may benefit from lessons learned. Other community-based fire management strategies are also growing across the country, including prescribed burn councils and associations, and public interest in better wildfire suppression is at an historic high following the 2017 wildfire season. The primary implication for management and practice is that such community-based approaches can offer significant assets to mitigation and suppression efforts, particularly in “working lands” communities, but challenges to the integration of informal and formal organizations must be proactively recognized and managed. Policy makers and managers should also consider how statutory basis, program design, and state agency roles shape community participation and community-agency relationships.

Implications for future research

This project is situated within a suite of broader research interests focused on questions such as institutional design for sustainable resource management, the dynamics of multi-level governance arrangements, and the social foundation of emergency response. Our project suggests several areas for future research. First, the proliferation of RFPAs and policy support for their existence is relatively recent, and their implementation remains dynamic. More study would further illuminate their ongoing evolution, particularly to identify if and how conflict that we observed may be ameliorated through adaptation; and to assess their economic and ecosystem service impacts and values such as avoided costs of suppression, economic activity generated, and wildlife habitat protected. Given that the RFPAs model is still evolving in both Oregon and Idaho and has recently been adopted in Nevada, there is a continued need to test the hypotheses generated by our initial research effort and track the evolution of the RFPAs model over time and across state contexts. Second, RFPAs may be analyzed in the larger context of other community-based fire management approaches to mitigation, suppression, and community responses during fire. These include collaboration, prescribed fire councils/associations, and alternatives to evacuation. All of these represent models of coproduction in which federal or state wildfire managers work directly with non-state actors to further the goals of sustainable fire management, and all represent models of multi-level environmental governance. Further research across these approaches could examine similarities and propose successful models for more fire-adapted communities. Third, refinement of the human ecology mapping method through studies with larger populations may allow

more robust comparisons of risk paradigms between different actors in wildfire risk management. Human ecology mapping indicated areas of consensus and potential conflict across the landscape, and suggested differences in response capability and geographic scope among the studies RFPAs. Further efforts in this vein could help to illuminate differences between RFPAs members and federal fire managers as well as differences between individual RFPAs within states or across state lines.

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Appendix A: Contact Information for Key Project Personnel

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Appendix B: List of Completed/Planned Scientific/Technical Publications/Science Delivery Products:

1. Articles in peer-reviewed journals (specify whether In Press, accepted for publication, in review [submitted for publication], or planned/in preparation).

Abrams, J., Davis, E.J. and Wollstein, K., 2017. Rangeland Fire Protection Associations in Great Basin Rangelands: A Model for Adaptive Community Relationships with Wildfire?. *Human Ecology*, 45(6), pp.773-785. In Press.

Abrams, J., Wollstein, K., and Davis, E.J. State Lines, Fire Lines, and Lines of Authority: Rangeland Fire Management and Bottom-Up Cooperative Federalism. Submitted to *Land Use Policy*. Submitted for publication/in review.

Davis, E.J., Abrams, J, and Wollstein, K. Fire on the Range: Emergent and Established Characteristics in Rangeland Fire Protection Associations. Submitted to *Disasters*. Submitted for publication/ in review.

2. Technical reports (specify whether In Press, accepted for publication, submitted for publication, or planned/in preparation).

All reports are published/in press.

Davis, E.J., Abrams, J., Wollstein, K. and Meacham, J.E., 2017. Rangeland fire protection associations: an alternative model for wildfire response. Ecosystem Workforce Program Working Paper #80. Institute for a Sustainable Environment, University of Oregon. In Press. Available at:
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https://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/BP_78.pdf

Northwest Fire Science Consortium Research Brief #16: Rangeland Fire Protection Associations: Institutional and Social Dimensions of an Alternative Model of Wildfire Response. In Press. Available at:
http://www.nwfirescience.org/sites/default/files/publications/NWFSC_RB16_RFPAs_Posting.pdf

3. Conference or symposium abstracts

- Wollstein, K., E.J. Davis, J.A. Abrams, J. Meacham, A. Steingisser, L. Cervený, and C. Moseley. “Survival in the ‘Grey Zone:’ Ranching and fire protection on the southeastern Oregon rangelands.” Presented at the International Symposium on Society and Resource Management. June 22-25, 2016, Houghton, MI.

Through self-organization as Rangeland Fire Protection Associations (RFPAs), rural landowners in Oregon and Idaho have increasingly gained the authority, tools, and skills to provide a first line of fire defense in areas with little or no organized state wildfire protection. This is a notable departure from typical government-led suppression approaches, and creates a novel space in which private landowners work alongside—or even in advance of—government fire crews. Currently, 18 RFPAs in Oregon protect over 3.9 million acres of private

land and over 545,000 acres of state land, and have initial attack capabilities on over 10 million acres of federal land. RFPAs offer a unique polycentric governance model for community wildfire response in rural areas while raising a series of questions about how they can best interface with agencies, safely respond to fires, and navigate a “grey zone” of ambiguous legal mandates and protections. Here we present preliminary results from research on the institutional changes that the advent of RFPAs has wrought, and the evolution of working relationships between RFPAs and government fire and land management agencies. We highlight important legal tensions in the institutional framework supporting RFPAs, and linkages to larger debates about public lands and ranching in the American West.

- Abrams, J., E.J. Davis, K. Wollstein, J. Meacham, A. Steingisser, L. Cervený, and C. Moseley. “When two worlds collide: Rangeland Fire Protection Associations, federal agencies, and the politics of resilience.” Invited presentation at Central Oregon Fire Science Symposium, March 21, 2016, Bend, OR.

Wildfires in Great Basin rangelands have grown in size and intensity in recent years, raising concerns about impacts on native habitats, rare species such as the greater sage-grouse, and the livelihoods of ranching families. Rangeland Fire Protection Associations (RFPAs), self-organized volunteer wildfire response teams made up of ranchers and other local community members, have emerged as a model of early rangeland wildfire response and have been formally sanctioned in Oregon, Idaho, and Nevada. With equipment and training from their respective states, RFPAs are positioned to contribute effort, local knowledge, and quick-response capacity to complement wildland fire suppression professionals from agencies such as the BLM. However, the largely informal approach to fire response typical of RFPAs stands in contrast to the highly formalized structure of federal agencies, setting up the opportunity for conflicts on the fireline and off. RFPA members see their lack of bureaucratic restrictions as an asset that allows them to be effective in fire response; for federal agency managers, this lack of adherence to bureaucratic standards can appear as an unacceptable risk. Is there room to accommodate flexible, informal organizations within a highly bureaucratized federal wildfire response system? What are the roles of state-level policies and agencies in mediating the conflict between national and local entities? In this talk we will introduce the RFPA model, describe conflicts that have arisen in their operations, discuss possible models for resolving these conflicts, and consider possibilities for maintaining the advantages of flexibility and informality while still providing for safety and accountability.

- Although our funding/project is complete and future presentations do not count in this report, we did want to share that Davis has delivered/will deliver four additional invited presentations in 2018, as there is continued interest in our research results.
 - Society for Range Management Annual Meeting invited presentation (done on 2/1/18)
 - Invited guest lecture in Oregon State University’s Natural Resources Management NRM 201 class (done on 2/6/18)
 - Invited guest seminar at Portland State University’s 2018 Winter Speakers Seminar on community resilience in social-ecological systems (scheduled for 3/8/18)
 - Invited panelist at Rural Sociological Society’s Annual Meeting, organized panel “Wildfire impacts, recovery, and resilience in the rural West (scheduled for 7/27/18)

4. Website development

Project website:

<http://www.nwfirescience.org/RangelandFireProtectionAssociations>

Project storymap:

<https://uo-online.maps.arcgis.com/apps/MapSeries/index.html?appid=95411f8de94f42edb0504f8a42de673a>

5. Presentations/webinars/other outreach/science delivery materials

- **Technical reports were handed out and briefly presented at two meetings:**
 - SageCon Summit, November 5-6, 2017, Baker City, OR.
 - Idaho Annual Meeting of Rangeland Fire Protection Associations. November 1-2, 2017, Boise, ID.

- **Two formal presentations were made to the state-level meetings of RFPAs in Oregon and Idaho:**
 - Davis, E.J., J.A. Abrams, K. Wollstein, J. Meacham, A. Steingisser, L. Cerveny, and C. Moseley. “Fire adapted communities on the range: Alternative models of wildfire response.” Invited presentation at the Oregon Summit of Rangeland Fire Protection Associations. May 16-17, 2017, Burns, OR.

 - Wollstein, K., E.J. Davis, J.A. Abrams, J. Meacham, A. Steingisser, L. Cerveny, and C. Moseley. “Fire adapted communities on the range: Alternative models of wildfire response.” Invited presentation at the Idaho Annual Meeting of Rangeland Fire Protection Associations. November 1-2, 2016, Boise, ID.

- **Web-based materials were created and shared:**
 - Esri story map web application:
<https://uo-online.maps.arcgis.com/apps/MapSeries/index.html?appid=95411f8de94f42edb0504f8a42de673a>

 - Project website:
<http://www.nwfirescience.org/RangelandFireProtectionAssociations>

- **Two webinars were delivered:**
 - Webinar with Northwest Fire Science Consortium on 6/7/17:
<https://www.youtube.com/watch?v=qwKPzrl2dLk>

 - Webinar with Great Basin Fire Science Exchange on 9/27/17:
https://www.youtube.com/watch?v=Oy-8_tHb40o

▪ **Five invited lectures were delivered:**

- Wollstein, K. Wildfire response in eastern Oregon. Building resilient communities? Winter 2016. Graduate presentation for Resilience Theory (GEO 520), Oregon State University.
- Wollstein, K. Ranching and wildfire protection: A community-based model. Winter 2016. Graduate presentation and facilitated discussion for Consensus and Natural Resources (FES 585), Oregon State University.
- Abrams, J. 2016. “Community-based fire management in the Northern Great Basin: Property, authority, and the politics of resilience.” Geography Spring Seminar Series, Oregon State University, Corvallis, OR, April 21.
- Abrams, J. 2017. “Landscapes of social and ecological change in the U.S. West: Communities, institutions, and authority in environmental governance.” Applied Biodiversity Science Seminar Series, Texas A&M University, College Station, TX. April 12.
- Abrams, J. 2017. “Geographies of weak-state environmental governance in the U.S. West.” Department of Geography “Tea Talk” Series, University of Oregon, Eugene, OR. January 26.

Appendix C: Metadata

Research was performed during 2015-16 using a qualitative interview and mapping process with two case study RFPAs in Oregon (Crane and Jordan Valley) and two in Idaho (Owyhee and Mountain Home). Perspectives on RFPAs and BLM values and risks were gathered across their respective landscapes by marking up paper maps made by University of Oregon's InfoGraphics Lab using Esri ArcGIS software. The base maps were later digitized, synthesized, and analyzed by the same group.

An inventory of spatial data layers used to create each map are listed in the Map Sources Inventory and Metadata spreadsheet uploaded to the Metadata location on the JFSP webpage.

Base data used to make all maps are secondary data and include data that is public domain and easily obtainable online, or proprietary data obtained from Esri as supplied with our institutional Esri license. Esri is the primary and most dominant software in geospatial analysis and visualization and as such, most anyone using GIS will have access to these data. The type of data access is listed in the Spatial Data Sources in the metadata spreadsheet.

Original data are data that were digitized and analyzed from the mapping portion of the qualitative interviews are listed by layer in the map inventory. Spatial data that were not confidential were archived with the US Forest Service Data Repository. Spatial data that were confidential (defined as data that does indicate or reveal places of work or residence) were not archived. Interview data including audio files and transcripts are confidential and protected by human subjects regulations put forth by OSU and UO's Institutional Review Boards, therefore they were not archived.