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# Effects of Wildfire on Collaborative Management of Rangelands: A Case Study of the 2015 Soda Fire

By Gwendŵr R. Meredith and Mark W. Brunson

## On the Ground

- Multi-jurisdictional rangeland “mega-fires” are becoming more common.
- Using interview data, we examined cross-boundary collaboration after the Soda Fire that burned approximately 113,312 ha (280,000 acres) of southwestern Idaho and southeastern Oregon.
- We found relationships established in other management contexts were activated by individuals within agencies to share funding and resources to rehabilitate the landscape after the Soda Fire.
- The fire’s spatial proximity to Boise, Idaho, and temporal proximity to important federal policy decisions were primary collaboration drivers.
- Barriers to collaborative efforts still exist; however, interviewees highlighted the importance of individual agency (bottom-up) changes in lessening top-down constraints.

**Keywords:** Mega-fires, ESR, Cross-boundary collaboration, Landscape-scale management, Bottom-up changes.

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## Introduction

Rangelands in the interior western United States represent a landscape mosaic of public and private ownership. Seventy percent of the Great Basin is public land<sup>1</sup>; thus, land managers from federal agencies such as the Bureau of Land Management and United States Forest Service, in conjunction with state agencies, are responsible for managing these

public lands. However, landscape-scale disturbances such as large wildfires and non-native species invasions affect multiple jurisdictions. Accordingly, restoration or rehabilitation post disturbance should ideally be collaborative. Past research suggests that cross-boundary entities that are able to balance centralized control and ad hoc collaboration are in a better position to manage crises.<sup>2</sup>

In this study we concentrate on the problems of wildfire and post-fire rehabilitation because their impact on the landscape can be drastic and affect key supporting, regulating, provisioning, and cultural ecosystem services provided by rangelands.<sup>3</sup> Although fire at natural intervals is a healthy and dynamic part of most ecosystems, wildfires in the Great Basin when fuel loading is high can lead to adverse consequences, such as soil sterilization and hydrophobicity, accelerated runoff and erosion, and conversion of native grass-shrub communities to non-native annual grassland dominated by invasive cheatgrass (*Bromus tectorum*) and medusa-head (*Taeniatherum caput-medusa*).<sup>4–6</sup> Sagebrush (*Artemisia* spp.) is slow to return to burned habitats and sagebrush-dependent species, such as the greater sage-grouse (*Centrocercus urophasianus*), are negatively impacted as a result.<sup>7</sup> Historically, wildfires varied in size and severity with a return interval of 100 to 150 years for large, severe fires, and smaller, less intense fires had a return interval of 20 to 40 years.<sup>8</sup> However, current fire return intervals on cheatgrass-dominated plant communities are now only 3 to 10 years.<sup>9,10</sup> Additionally, “mega-fires,” large-scale wildfires burning 40,469 ha (100,000 acres) or more, are increasingly prevalent.<sup>11</sup> In 2007, the Murphy Complex fire burned 263,862 ha (652,016 acres) in Idaho and Nevada. In 2012, the Long Draw Fire burned 225,672 ha (557,648 acres) in southeastern Oregon. In 2015, the Soda Fire, the fire of interest within this study, burned 112,966 ha (279,144 acres) in southwestern Idaho and southeastern Oregon. More recently, the Martin Fire burned 176,269 ha (435,569 acres) in northern Nevada in 2018.

With increased incidence of large-scale, multi-jurisdictional wildfires on rangelands, and the potential ecological and economic costs resulting from suppression and rehabilitation efforts, understanding the dynamics of cross-boundary collaboration is useful for confronting the challenges posed by mega-fires. However, collaborating

on restoration can be problematic when the agencies and stakeholders have diverse institutional cultures, protocols, mandates, and political realities.<sup>12–15</sup> In a study of wildland interface fires in the US Northwest, Faas et al. found that federal land agencies served as a “bridging actor,” an intermediary between two or more unconnected actors, even though they were A) not the entity others anticipated seeking out and B) one of the least trusted entities within the network.<sup>16</sup> Thus, having a nuanced understanding of how federal land agencies are interfacing with other stakeholders in post-fire rehabilitation efforts can point toward potential future organizational changes that could ultimately build trust.

## Soda Fire case study

We conducted a case study to understand how collaborative management efforts were altered after a large-scale wildfire that crossed two states and multiple field office jurisdictions. Using semi-structured interviews, we identified 1) collaborative efforts before, resulting from, and after the Soda Fire; 2) barriers to landscape-scale collaborative management; and 3) opportunities for continued and increased participation in collaborative processes. Our case study approach is drawn from Merriam’s constructivist framework for case study definition, design, and data gathering and analysis.<sup>17</sup>

## Study area

Lands within or near the 112,966 ha (279,144 acres) burn area resulting from the 2015 Soda Fire were the focus of this research. We chose to examine the Soda Fire as the most recent example of a large-scale post-wildfire rehabilitation effort crossing multiple jurisdictional boundaries, including state lines. These lands includes parts of Owyhee County, Idaho, and Malheur County, Oregon. The burn was mainly on Bureau of Land Management (BLM) managed lands but also included state trust lands and private inholdings. Notably, the fire impacted approximately 80,937 ha (200,000 acres) of greater sage-grouse habitat, segments of 41 grazing allotments, three wild horse areas, and a popular recreation area (Fig. 1).<sup>18</sup>

## Participant interviews

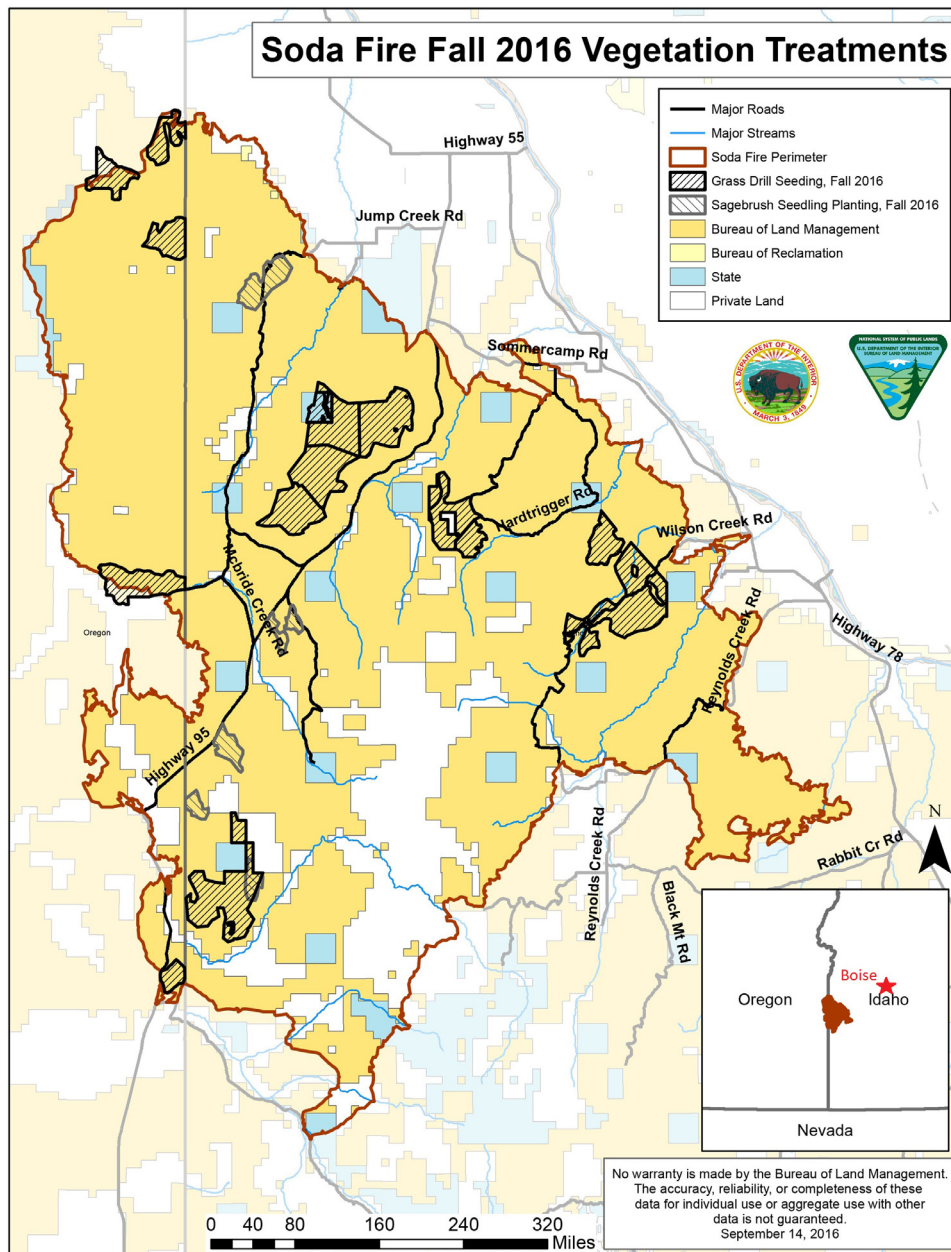
To better understand how land managers collaborated both before and after the Soda Fire, we used snowball sampling methodology<sup>19</sup> to conduct semi-structured interviews with individuals from federal and state agencies as well as private landowners. Snowball sampling uses initial informants to nominate other participants who could potentially contribute to our study. For incorporation into the social network, actors had to be part of the event (i.e., Soda Fire rehabilitation response). However, because we were interested in the context in which the Soda Fire rehabilitation effort occurred, our interview criteria also included those who were not part of the for-

mal institutional response to the Soda Fire but A) perceived they should have been and/or B) were involved in collaborative efforts within the proximity of the study area before and after the Soda Fire.

From November 2018 to March 2019, we spoke with 24 individuals who were directly or indirectly involved in post-fire collaborative processes on the lands burned by the Soda Fire and/or pre-fire collaborative restoration efforts within the vicinity of the Soda Fire. In examining pre-fire collaborative processes, we focused on collaborations 5 years before the 2015 Soda Fire up to the date of the interview; however, collaborations before 2010 were considered if interviewees mentioned their significance leading up to the Soda Fire. Individuals were interviewed from the Idaho and Oregon BLM, US Geological Survey (USGS), US Fish and Wildlife Service (USFWS), USDA – Natural Resources Conservation Service (NRCS), USDA – Agricultural Research Service (ARS), Idaho State Department of Agriculture (ISDA), Idaho Department of Lands (IDL), Idaho Department of Fish & Game (IDFG), Idaho Governor’s Office of Species Conservation (OSC), Owyhee County, Owyhee Rangeland Fire Protection Association, Jordan Valley Cooperative Weed Management Area, The Nature Conservancy, and private landowners.

The interviews were conducted using a predesigned script but were semi-structured so that new topics could be explored as they emerged in discussion. Interviews were audio-recorded and transcribed for coding. The interview protocol was reviewed and approved by the Institutional Review Board at Utah State University as protocol #9537. We conducted thematic analysis of the interview transcripts to search for patterns and emergent themes in interviewee’s responses to questions.<sup>20</sup> In order to investigate collaborative management efforts before and after the Soda Fire, we asked participants’ about their definition of successful collaboration, with whom they collaborated with in the 5 years before/since the Soda Fire, how successful they perceived the Soda Fire collaboration to be, and what outcomes resulted from the collaboration. For the full list of questions, see [Appendix](#).

Mattessich et al.’s<sup>21</sup> framework was used to distinguish cooperation, coordination, and collaboration. Cooperation is characterized by informal relationships in which entities function separately with no required joint planning and share information only as needed. Within a cooperative relationship, resources are separate, and thus authority and accountability also reside within each individual entity. Often cooperation is present in an as-needed basis with no specific time limit. Coordination usually takes place around a specific project with a mission that has at least been reviewed for compatibility by the separate entities. Coordination is characterized by partial sharing of leadership although entities maintain separate identities and assume needed roles and openly communicate frequently. Finally, collaboration requires a common mission with a formal division of labor centered around one or more long-term projects. In contrast to both cooperation and coordination, collaboration is char-



**Figure 1.** Burn perimeter of the 2015 Soda Fire, including land tenure and 2016 vegetation treatments.<sup>31</sup> Bureau of Land Management License CC-BY. Available at: <https://idfg.idaho.gov/blog/2016/09/treatments-continue-owyhee-countys-soda-fire>.

acterized by dispersed leadership with equal risk shared by all entities. To reflect common usage, we refer to each of these types of activity as “collaboration” until the discussion section, in which we more carefully dissect interviewees’ relationships.

A social network of collaborations resulting from the Soda Fire rehabilitation efforts was created for visualization purposes. By constructing a visual representation of the Soda Fire collaborative efforts, we achieved a qualitative overview of the data that could be investigated further through thematic analysis.

## Results

Our analysis of the interview transcripts helped us characterize cross-boundary collaboration before, resulting from,

and after the Soda Fire; identify key insights from the collaborative process; and pinpoint barriers to collaboration.

### Cross-boundary collaborative management – before the Soda Fire

Much of the collaborative management occurring before the Soda Fire pertained to restoration of greater sage-grouse habitat and evaluation of grazing impacts. In speaking of their collaborations 5 years before the Soda Fire, interviewees emphasized projects concerning fuel breaks, control of noxious weeds, and removal of juniper. Interestingly, these are the same types of projects mentioned after, but not directly resulting from, the Soda Fire. Collaborative groups such as the Owyhee County Sage-Grouse Local Working Group and



Owyhee Initiative were mentioned as being particularly active at this time. To understand the emphasis on greater sage-grouse landscape restoration, it is important to know the contexts of two federal decisions.

On January 5, 2015, then-Secretary of the Interior Sally Jewell signed Executive Order 3336, which called for improved coordination in addressing rangeland wildfire and its impacts on wildlife, recreation, and economic activity. The Order explicitly mentioned conserving habitat for sagebrush-steppe dependent species such as greater sage-grouse. From August 10 to 23, 2015, the Soda Fire burned approximately 113,312 ha (280,000 acres), of which 20,234 ha (50,000 acres) were priority habitat for greater sage-grouse. The USFWS's decision deadline on whether to list the greater sage-grouse as a threatened or endangered species was set for September 30, 2015, and multiple interviewees mentioned that this increased their involvement and the funding they had available. The Idaho BLM relayed that "because of the sage-grouse potential listing all the other agencies had bigger pots of money." One of the agencies with funding reserves for such sage grouse-related projects was the Idaho Governor's OSC. An OSC employee described the Soda Fire as "one of the big fires that happened while all this ESA and sage grouse talk was going down, so we were like, 'We need to do something.'" The timing of the Soda Fire between that of Executive Order 3336 and the USFWS sage-grouse listing decision deadline placed the rehabilitation process under the spotlight of federal agency administration and the greater public. As one USFWS employee stated, "I think there was a point made somewhere along the line that the Soda Fire was going to be the pilot for that executive order."

Certainly, Executive Order 3336 and the potential sage-grouse listing created a window of opportunity for forging new collaborative relationships in rehabilitating the Soda Fire landscape (discussed below); however, for most interviewees these relationships already existed. As one employee of IDL said, "Sage-grouse is a big thing here, so we have relationships with our federal partners and with our lessees on sage-grouse habitat. This [Soda Fire collaboration] was just an extension of those relationships."

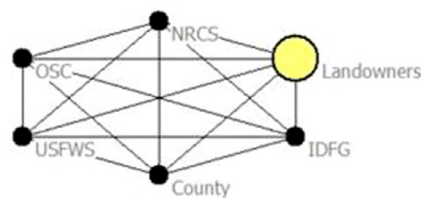
### Cross-boundary collaborative management – resulting from the Soda Fire

*I was amazed at how much planning and collaboration went into [the] Soda Fire. I could just see this is a new era in management and it's something that was really needed.*

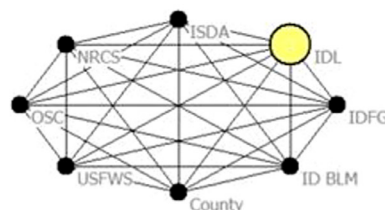
– IDFG employee

As portrayed in the above quote, the Soda Fire rehabilitation effort was a unique effort to embody the "all hands, all lands" approach<sup>22</sup> to management of resilient landscapes. In rehabilitating the lands that burned at the landscape-scale, the collection of actors involved was different depending on the land ownership or jurisdiction to be addressed: private lands, state managed lands, and federally managed lands (Fig. 2).

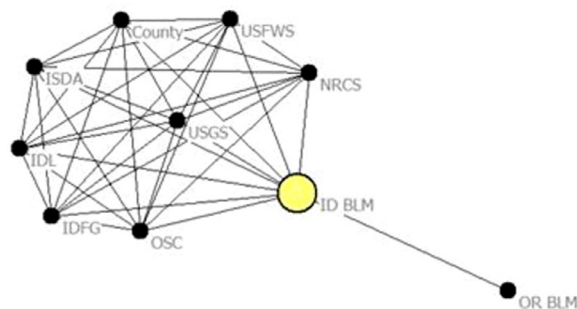
#### PRIVATE LANDS



#### STATE LANDS

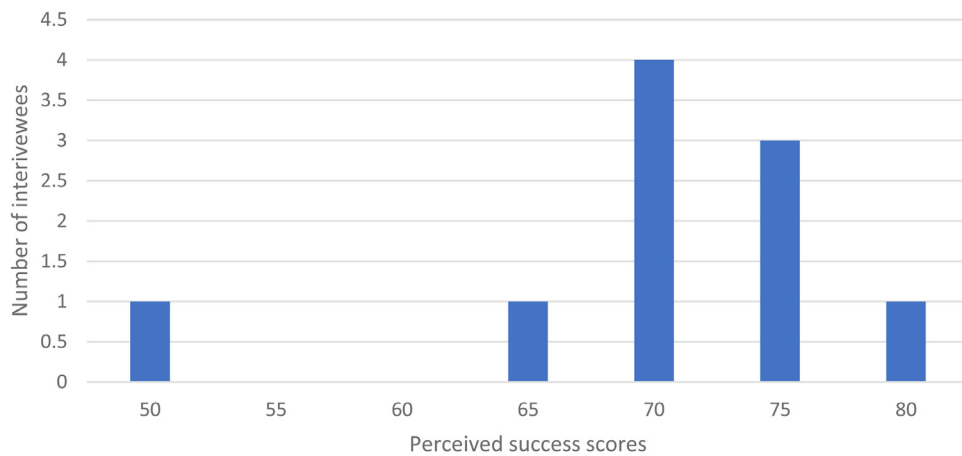


#### FEDERAL LANDS



**Figure 2.** Collaborative management network within each land type (i.e. private, state, and federal). Nodes (circles) represent agencies, organizations, or groups of individuals. Lines between nodes represent collaboration/coordination/cooperation broadly. Large yellow node signifies which entity is predominately in charge of decision-making.

In the context of the Soda Fire rehabilitation efforts, the state and federal lands were effectively managed together (Fig. 2). State and federal entities worked together via a memorandum of understanding to ensure that vegetation treatments, drill seeding, and particularly aerial grass seeding were largely seamless across federally and state-owned land boundaries. As one OSC employee stated, this arrangement arose out of concern that there'd be "a donut hole [of state land] out there that turns to annual grasses." However, the private land rehabilitation process was separate because of funding constraints. With the BLM unable to fund private land rehabilitation, other agencies coordinated assistance to landowners. State agencies and the USFWS coordinated with the NRCS so that they could contribute toward a cost-share for spraying pre-emergent herbicide to suppress competition with native seed the first year, and the NRCS could do the same for seeding the following year on private lands. However, few landowners applied for this assistance, largely because they needed their private lands to feed cattle since their grazing allotments on federal and state lands had burned and required mandatory rest.



**Figure 3.** Histogram of interviewees' perceived success scores of the Soda Fire rehabilitation collaboration.

The level of collaboration between management entities post-wildfire varied. As one NRCS employee explained, "Our biggest benefit of the inter-agency collaboration is allowing us to share resources and information with each other, so we can get the most efficient and beneficial use of the funds that we have available." For this individual, sharing information so that NRCS would know how to best distribute funds was important; however, some agency employees described their collaboration in post-fire rehabilitation to be more defined by technical assistance. Although some interviewees said their collaboration consisted of shared decision-making, more described an arms-length collaborative process, such as that explained by an ISDA employee: "There were definitely times where the group felt like we were just being updated rather than providing input that action was taken on, but it was definitely better than what we usually get." This opinion was shared by an NRCS employee who stated, "We were kind of limited on how much input we could provide on that initial restoration response, but we were informed, which was more information than all of us partners had really ever received before." In the quote above and the previous quote from an ISDA employee, both individuals felt restricted but simultaneously thankful for the line of communication opened during this collaborative process.

When asked to quantify the perceived success of the overall Soda Fire rehabilitation collaboration, interviewees who responded to the question (42% of the total sample) were consistent in their responses (Fig. 3). The mean, median, and modal response each was 70, where 100 = extremely successful. One individual did not provide an overall score but rated each agency separately, giving the BLM a score of 20 while rating the other collaborators on private lands at 95. This interviewee expressed concerns that cattle grazing was prohibited beyond the necessary time frame for sufficient rangeland rehabilitation, which in turn negatively impacted ranchers' livelihoods. This response was not included in our analysis but does offer an alternative perspective. Collaborations both before and after the Soda Fire that didn't directly relate to the fire varied in purpose and participants; thus, we did not average across ratings for these collaborations and

only focused on the Soda Fire rehabilitation collaborative effort.

There was a noted divergence between management on the Oregon and Idaho sides of this fire. Several interviewees believed that post-fire rehabilitation was more a priority, socio-politically, on the Idaho side than the Oregon side. As an employee of the Oregon BLM explained, "I felt like there was definitely more emphasis from the Idaho side than there was on the Oregon side, so getting both sides on the same page in terms of importance and scale and how we were going to approach this was a challenge from the beginning." Interviewees mentioned that Oregon had its own process, and while there was communication across the state boundary there was not collaboration in the sense of seamless treatment strategies. Indeed, grass drill seeding was completed separately in Oregon and Idaho (Fig. 1). A USFWS employee expressed that "the collaboration was not cross-jurisdictional from at least a state perspective. That's not to say that what they did was better or worse. I'm just saying it's certainly not the same." Some interviewees suggested that rehabilitation was a bigger priority in Idaho because of 1) its proximity to the state capital, Boise (Fig. 1); 2) attention from disgruntled stakeholder groups, such as some environmental groups and grazing permittees; and 3) the amount of priority greater sage-grouse habitat that was negatively affected by the fire.

### Cross-boundary collaborative management – after the Soda Fire

When asked about collaborations after the Soda Fire, interviewees frequently described collaborative projects similar to those occurring before the Soda Fire on issues like fuel breaks, noxious weed control, and juniper removal. For instance, the Oregon BLM mentioned that "a lot of the collaboration that started with Soda is helping us with Tri-State." This is a reference to the Tri-State Fuel Breaks Project, a large-scale BLM-led network of fuel breaks across parts of Idaho, Oregon, and Nevada that was in initial planning stages at the time of our interviews and was approved by the US

Department of Interior in May 2020. It became clear from the interviewees that collaborations after the Soda Fire were products of prior collaborations that continued or revived once the Soda Fire rehabilitation effort slowed. One USGS employee explained that “things will just kind of morph and we’ll work on the same kind of themes but in new contexts. It won’t be like a comprehensive response to a specific fire. It’s going to be more on specific control options for cheatgrass or studying the effectiveness of fuel breaks.”

An Oregon BLM employee provided an example of this when mentioning that they are “now looking at a kind of pasture-scale targeted grazing research effort. That’s another example where collaboration that began during Soda spawned another effort of BLM’s working with our partners to address this fire issue in sagebrush steppe.” In fact, this collaborative project using targeted grazing for fuel breaks was the only project interviewees mentioned after but not before the Soda Fire. All other collaborations interviewees brought up were present both before and after the Soda Fire. This is because, as an Idaho BLM employee put it, “There’s never a beginning and an end to collaboration.” Rather, it appears in this context that collaborations are driven by 1) obvious need (i.e., wildfire) and 2) agencies’ current management priorities, which often shift with administrative changes.

Although collaborations between agencies may be fairly constant, collaborations between individuals within separate agencies have a starting point. For a couple of the interviewees, new connections that were forged as a result of the Soda Fire collaborative efforts continued after rehabilitation efforts, as this IDFG employee exemplified, “[X at the BLM] and I built a relationship that kind of started with Soda. His email was on the collaborative. That’s when I really met him.” Because, ultimately, collaborations occur between individuals, not agencies, the Soda Fire collaboration provided an opportunity for individuals to start or maintain partnerships and learn from each other. These relationships then evolved as needs and priorities shifted and new projects arose.

## Key insights

In learning about each other, collaborators were able to garner a better understanding of agency processes other than their own. For instance, one NRCS employee mentioned, “I think we all learned quite a bit because we didn’t know how the BLM did it before and so now it makes more sense. And so we’re hoping that the next time we will have a little better understanding of how the process works and we can actually facilitate a better partnership.”

An Oregon BLM employee also came to the conclusion that “a lot of the collaborators had a misconception of what the BLM did or didn’t do post-fire, so I think Soda brought a lot of opportunity for those players to know the process that we go through.”

In addition, the Soda Fire provided a window of opportunity for learning about post-fire recovery. Through a unique partnership with USGS, extensive monitoring of the Soda Fire landscape is being conducted. Several interviewees men-

tioned how the monitoring will be beneficial in the future. For instance, an NRCS employee stated that “what came out of this is that they monitored the entire fire, so next time there’s a big fire, there’s a baseline dataset.” Likewise, an individual from the Oregon BLM thought that the monitoring “is something to be really proud of . . . and that’s probably where we were the most stable and had no boundaries.”

Frequently, interviewees described tangible outcomes resulting from the Soda Fire collaboration. An Oregon BLM employee mentioned that because of the Soda Fire “many of the things we learned in Soda are going to be used to change our ESR (Emergency Stabilization and Rehabilitation) handbook within BLM.” In the same vein, an OSC employee stated that “something that has probably resulted from the Soda Fire is the BLM is now bringing a point of contact from the IDL and IDFG to the table to create an ESR plan.” Thus, lessons learned during the Soda Fire effort may be incorporated into future ESR efforts in the region and more individuals are providing input as to what those lessons may be. For instance, as this USFWS employee explained, the USFWS is also more involved with the BLM as a result of the Soda Fire:

*Our relationships with agency partners have been strengthened through our efforts on the Soda Fire. One very strong and tangible example of that is we have now partnered with the BLM to co-locate three USFWS positions in three BLM District offices to increase our capacity to partner in the same type of way.*

The Owyhee Rangeland Fire Protection Association, involved in fire suppression rather than rehabilitation efforts, has also strengthened relations with agency partners since the Soda Fire. An Owyhee Rangeland Fire Protection Association member voiced that “to have the BLM and IDL get us more and better machinery is something that the Soda Fire really spurred up. It makes a huge difference when you have dependable vehicles you can go out there and fight fire with.” Because of the positive outcomes resulting from the Soda Fire collaboration, this approach to post-fire rehabilitation may become formalized within the state of Idaho. Employees of the Idaho BLM mentioned that while “the Soda Partners group isn’t really formalized; it is starting to be formalized. The strategic group at the state office is taking what [X] did with Soda and ensuring that it happens on a statewide scale. . . . They realized it was a cool thing.”

## Barriers to cross-boundary collaboration

Although new connections can be forged as a result of landscape-scale disturbances, such as the Soda Fire, hierarchical relationships within government organizations can present barriers to collaboration. For example, while the USGS was very involved with the rehabilitation effort, another research agency, the USDA ARS, had limited engagement although the fire crossed part of an ARS research area. As a Department of Interior agency, USGS has a role to provide scientific assistance to other Department of Interior agencies such as the BLM. ARS potentially could have provided valuable data

or new research after the Soda Fire, but was not asked to do so, likely because of its position outside the Interior Department hierarchy. As one ARS employee stated:

*Why the BLM has not engaged with ARS has been a question of ours for a number of years . . . We produce tons of results and data that are used around the world and they should hold us up as a trophy and they just don't. I'm not blaming any one person. It's an agency-wide mentality. It's kind of institutionalized within them.*

For those who were included within the collaborative rehabilitation process, many shared positive outcomes of the Soda Fire rehabilitation collaboration, but also concern that the Soda Fire was a product of the socio-political climate at the time and that future fire responses might not be as comprehensive. Although Idaho BLM employees mentioned the potential for formalization across the state of collaborative efforts resembling the Soda Fire Partners group, they also provided the following caveat:

*Soda was a really unique project in a unique time and we were allowed to think outside the box and that's probably why we had such a big partnership and collaboration, because it was an exciting time. And the follow-through on that has kind of dropped off. It's unfortunate that everything we learned is kind of insignificant now.*

A USGS employee echoed this concern, saying, “the real hope is that you do something like this for one project but the good principles and good partnerships are brought into subsequent projects, and I haven't seen that happen.”

Some interviewees mentioned that shifting agency priorities, enforced via top-down processes from agency headquarters to field staff, have impacted what they focus their time on; however, interviewees also mentioned bottom-up processes, such as individuals' capacity for engaging in post-fire collaborative processes regardless of restrictive top-down imperatives, as a possible solution. For example, an employee of the USFWS described:

*The agencies are not built to handle long-term commitments. The personnel, the funding streams, the policies aren't well adapted for that, so we need to change some of that. . . but the individuals need to try and take ownership for the long term too. I think if we expect more individually, that we can each individually make a difference.*

Additionally, a USGS employee highlighted the importance of individual agency in forming post-fire rehabilitation efforts like those after the Soda Fire, “Projects like this really come down to individuals and if individuals believe in something they are going to make it happen, irrespective of whether their time is specifically ascribed to it, because things like this require individuals to go way beyond what they are paid to do.”

## Discussion and policy implications

The National Cohesive Wildland Fire Management Strategy, initiated in 2010, sets out to promote collaboration between governmental and nongovernmental agencies, individuals, and other interests in addressing landscape-scale wildland fire management.<sup>23</sup> This “all hands, all lands” approach has gained momentum in the last decade but its success is dependent on collaborative relationships across land tenure boundaries.<sup>22</sup> However, few wildfire-related studies have evaluated how stakeholders are working across connected rangeland landscapes.<sup>22,24–27</sup> Thus, while our research is a case study, it has wide applicability to other rangeland systems and can help managers identify opportunities to increase collaboration on rangelands with cross-jurisdictional processes, such as wildfire and invasive species.

According to interviewees, the Soda Fire rehabilitation collaboration was better than the status quo. However, even interviewees who were satisfied with the collaboration observed that the “collaboration” was mainly communication and not shared decision-making. In practice, “collaboration” varied from shared decision-making, shared funding, and/or technical assistance. Using Mattessich et al.'s<sup>21</sup> definitions of cooperation, coordination, and collaboration, we conclude that the Soda Fire “collaboration” was largely coordination, because leadership was not shared and resources were not pooled overall. This “arm's length” posture has been posited as an effective strategy when there is a power imbalance between stakeholders (i.e., in collaborative groups with private landowners) because it minimizes the amount of time dedicated to procedural concerns (e.g., Federal Advisory Committee Act) while still allowing information sharing.<sup>28</sup> Reaching true “collaboration” across federal, state, and private lands is still possible, but does require a re-evaluation of how policies and incentives impact these actors.

### Opportunities for future landscape-scale collaboration improvements

The state of inter-agency collaboration within the context of the Soda Fire rehabilitation effort is complex and varied by agency. There were essentially three management processes occurring at once—those on private lands, state, and federal lands. Some of these entities worked better together than others. For instance, Oregon and Idaho BLM offices were in communication but ultimately chose different treatments on their lands. In the case of the Soda Fire, rehabilitation efforts in Idaho were a greater priority because of the burn area's proximity to the state's largest metropolitan area, the amount of lost greater sage-grouse habitat, and the presence of an active ranching community and environmental interest groups. The combination of the pending sage grouse listing decision and the socio-political climate that incited collaboration also prioritized other burn areas in Oregon over those that burned during the Soda Fire. It is beyond the scope of this study to assess the effectiveness of those treatments; however, managing lands differently within the area burned by a single fire



confounds any potential benefits of cohesive landscape-scale management. Creating incentives for adjoining states to work together across connected landscapes would potentially minimize mismatched management strategies. However, evaluating how best to coordinate agency management efforts across state lines is an avenue of research that still requires more exploration and is likely case-dependent.

In the case of the Soda Fire rehabilitation, state and federal entities cooperated effectively because an MOU was established. This allowed state and federal lands to be managed more holistically than in the past and may be something that other collaborative rehabilitation processes could benefit from. Despite this improvement on federal and state lands cooperation, private lands were still managed separately from state and federal lands. State agencies, USFWS, and NRCS worked together to provide a cost-share for private landowners on herbicide spraying and subsequent seeding. This effort is also something that could be emulated by those engaging in future rehabilitation collaborations. However, these programs will have limited impact unless landowners have flexibility within their ranching operation to apply for assistance. Multiple interviewees mentioned that a grassbank<sup>29</sup> or grasslands insurance would ameliorate the impact of wildfires on private landowners and allow them to participate more freely in treatments on their private lands.

Although private landowners ultimately decide which treatments occur on their lands, the decisions are impacted by the BLM's decisions about when to resume grazing on federal allotments. Similarly, the IDL is the ultimate authority for treatments on state lands, but because of the checkerboard nature of IDL (state) managed parcels within larger tracts of BLM land, they were greatly affected by the decisions of the BLM as well. For better or worse, the BLM had the most power in this landscape rehabilitation, so they also had the greatest capacity to serve as bridges to other agencies and entities. This finding is in accordance with past research examining the social dynamics of post-fire responses.<sup>16</sup> In this case the BLM encouraged other agencies to be part of the rehabilitation response. As a result, individuals within these other agencies were better able to understand the constraints the BLM operates under and learn more about how they can interface with the BLM in the future. This incremental individual learning can then contribute to increased institutional capacity for future fire events. A potential way to accelerate this learning is through arrangements like the BLM and USFWS now have within this study area. By locating some USFWS positions within BLM district offices, they've been able to increase their capacity to collaborate.

It is important that relationships forged during collaborative landscape rehabilitation are carried into subsequent collaborations so that collaborators can build off of their past knowledge and experiences with each other. Collaboration researchers often argue that crises can serve as windows of opportunity for bonds to be formed and action to take place.<sup>13,30</sup> Certainly, new "collaborative" relationships were forged during the Soda Fire rehabilitation efforts and provided an opportunity for learning; however, the partner-

ship mainly capitalized on established relationships from other management efforts. A study of wildfire response networks in Sweden and Canada found that pre-existing relationships composed 54% to 82% of all collaborations.<sup>27</sup> Our examination of the Soda Fire rehabilitation collaboration supports this finding. However, with high employee turnover rates, agencies need to support transitions in relationships so that associated collaborations can be maintained, thereby facilitating effective rehabilitation after wildfire. Incentivizing employees to stay in one field office or hiring new employees in time to overlap with their predecessors is one practical way that agencies can create an environment conducive to building trust with other agencies and private landowners.

## Conclusions

Increasingly, large-scale wildfires of more than 40,469 ha (100,000 acres) are burning western US rangelands,<sup>11</sup> with negative impacts to plant communities, soils, wildlife, and livelihoods. Because wildfires burn irrespective of public and private land management boundaries, multiple agencies are sometimes tasked with post-fire rehabilitation on the same landscape, only separated by man-made boundaries. When lands burned by a multi-jurisdictional fire are rehabilitated independently, there can be a loss of landscape continuity that alters ecological processes and eventually human systems. Therefore, understanding the strengths and limitations of inter-agency collaboration and opportunities for continued growth is critical.

For the 2015 Soda Fire rehabilitation effort we evaluated the state of collaboration, including the impetus for collaboration, perceived barriers to continued collaboration, and key insights gleaned from the Soda Fire collaboration that could be used to improve future landscape-scale collaborations. Certainly, there are regulatory limitations to collaborations among government agencies and between agencies and other entities (i.e., nonprofits, private landowners, general public, etc.). These obstacles to collaboration can include differences in organizational norms and culture, conflicting goals and missions, constrained resources, inflexible agency policies, funding streams, employee turnover rates, mistrust among stakeholders, and a culture of litigation. However, bottom-up processes, such as individuals' power to initiate collaborations, should not be underestimated. Ultimately, effective collaborations happen between individuals once trust is established. While calls for collaboration might ebb and flow due to socio-political factors, latent established relationships can be reactivated in new contexts regardless. Furthermore, through bottom-up processes, organizational culture can be an emergent property of incremental choices individuals are making. Thus, while top-down processes are often cited as a limitation to strengthening collaborative connections, bottom-up processes can counteract these constraints to a degree and work toward lessening them in the future.

## Declaration of Competing Interest

G.R.M. is a Guest Editor for this Special Issue of *Rangelands* but was not involved in the review or decision process for this manuscript. M.W.B. is a past member of the *Rangelands* Steering Committee but was not involved in the review or decision process for this manuscript.

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## Supplementary Materials

Supplementary material associated with this article can be found, in the online version, at [10.1016/j.rala.2021.03.001](https://doi.org/10.1016/j.rala.2021.03.001).

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