THESIS

PRIOROTIZING RESTORATION AND FIRE PREPAREDNESS AT

THE PUBLIC-PRIVATE BOUNDARY

Submitted by

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In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Summer 2018

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ABSTRACT

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System processes, like wildfire, will continue to threaten life and property, particularly if land managers cannot work across the public-private boundary at large enough scales. Addressing the wildfire challenge will require more natural fire use and other fuel reduction strategies, like mechanical thinning and prescribed fire, to reduce hazardous fuels. As the wildland-urban interface continues to expand, so does the need to work across the public-private boundary and engage private landowners to create defensible space and address fuel loads where the goal is to reduce fire hazard. This two-part thesis informs the prioritization of funding and management activities related to wildfire management across the public-private boundary. Chapter One of this study reviews three Colorado wildfires, identifying the true costs of the fires through document review and conversations with government and community personnel. This cost data demonstrates the long-term unsustainability of current wildfire management and informs prioritization of funding and management based on an area's forest and land-use type. Chapter Two evaluates the effectiveness of the Joint Chiefs Partnership in tackling the challenge of large-scale, collaborative, cross-boundary work, based on the adaptive governance literature and my qualitative research on the Partnership to understand which aspects of the design of the authority supported that goal. Our research investigated the complete cost of wildfire and the effectiveness of the Joint Chiefs Partnership to inform prioritization of funding for restoration

and fire preparedness and understand how policy can be better designed to support such work,

particularly across agencies and jurisdictions.

ACKNOWLEDGEMENTS

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THESIS OVERVIEW

The management of wildfire on public and private lands in the Western United States has become increasingly challenging over the past few decades. Average fire season length, number of large fires, and annual area burned are increasing (Calkin et al. 2014; Stephens et al. 2016). Forest managers have struggled to implement effective fuel reduction and forest ecosystem restoration treatments to address these issues, particularly at the intersection of public and private lands (Schoennagel et al. 2009, 2017). Addressing the wildfire challenge will require more natural fire use and other fuel reduction strategies, like mechanical thinning and prescribed fire, to reduce hazardous fuel build-up (Steelman 2016; Stephens et al. 2016; Seielstad 2015). The potential for use of natural fire to reduce fuel loads is limited as populations grow and the wildland urban interface (WUI) expands (Calkin et al. 2014; Stephens et al. 2016). As the WUI continues to expand, so does the need to work across the public-private boundary and engage private landowners to create defensible space and address fuel loads where the goal is to reduce fire hazard (Schoennagel et al. 2017). System processes, like wildfire, will continue to threaten life and property if land managers cannot work across the public-private boundary at large enough scales (Agee and Skinner 2005; Theobald and Romme 2007; Moritz et al. 2014).

We designed a two-part research project to inform the prioritization of funding and management activities related to wildfire management across the public-private boundary. Chapter One of this study reviews three Colorado wildfires with the objective of identifying the true costs of these wildfires, the factors that contribute to those costs, and evaluating how the fire costs may vary by forest and land use type. Chapter Two of this study focuses on two primary questions, with the goal of improving understanding about policy design to support work across

agencies and jurisdictions: 1) What aspects of the design of the authority supported progress in accomplishing cross-boundary work? 2) What other factors helped or hindered efforts to work across boundaries?

This study took place in several stages. I began gathering cost data for three Colorado wildfires in January 2016 to develop a deliverable for the Colorado State Forest Service. Data was discovered through document analysis, email conversations, and phone interviews. That deliverable represents the first chapter of my thesis. In May 2017, a research group, led by Dr. Schultz, conducted more than 130 interviews regarding the success of the Joint Chiefs Landscape Restoration Partnership and the Collaborative Forest Landscape Restoration Program. I conducted 62 of those interviews to explore questions around innovations, program successes, challenges, and next steps surrounding implementation of Joint Chiefs Partnership projects. We synthesized this information into an 80-page practitioner report at the request of the U.S. Forest Service and presented our findings to Forest Service program directors in November 2017. Interview data gathered for this report was used to develop my second thesis chapter.

This thesis was a two-part, applied project and the information gathered in this study was synthesized into three deliverables. Two of those documents follow, excluding the practitioner report, and form the body of my thesis. Chapter One is a product prepared for review and distribution by the Colorado State Forest Service to inform stakeholders of the true cost of wildfires in Colorado and how those costs differ depending on ownership type. More detailed cost tables with sources are provided in Appendix A. Chapter Two consists of a manuscript prepared for publication examining the effectiveness of the Joint Chiefs Partnership in tackling the challenge of large-scale, collaborative, cross-boundary work, using the policy design literature to understand which aspects of the design of the authority supported that goal. We also investigated the factors and underlying conditions that helped projects be successful and what factors got in

their way. The interview guide and coding methodology used for Chapter Two is provided in

Appendix B and C.

CHAPTER ONE

AN ECONOMIC ASSESSMENT OF SELECT COLORADO WILDFIRES

1. LITERATURE REVIEW

1.1 Background Information

Across much of the Western United States, average fire season length, number of large fires, and annual area burned are increasing (Calkin et al. 2014; Stephens et al. 2016). Increased density of shade-tolerant trees, dead fuel accumulations, fuel continuity, and climate change have caused a rise in high-severity wildfires in the United States, or those that have large footprints and cause loss of life and property (Donovan and Brown 2007; Omi and Martinson 2004; Steelman 2016). Continued emphasis on fire suppression creates a wildfire paradox, first termed by Brown and Arno (1991), whereby continued fire exclusion leads to an exponential increase in wildfire management and suppression costs. Reinhardt et al. (2008) argues the way to repair this paradox is to create conditions where fire can occur without the need for suppression, rather than creating conditions where fire is easier to suppress. As suppression efforts in the Western United States continue, the potential for natural fire to reduce fuel loads is limited (Abatzoglou and Williams 2016; Calkin et al. 2014).

The potential for use of natural fire to reduce fuel loads is limited because of the increased need for suppression as populations grow and the Wildland-Urban Interface (WUI) expands; therein lies another component of the wildfire paradox (Calkin et al. 2014; Stephens et al. 2016). The WUI, most simply, includes areas of human development that intermingle with wildlands (Reilly 2015). The presence of a WUI exacerbates the cost of wildfires as property values and insurance losses are at risk (Gorte 2013). The WUI has expanded to more than 12.5

million housing units as of 2000, an increase of 52 percent, since 1970 (Theobald and Romme 2007). It is estimated that the WUI will continue to expand, particularly in the Intermountain West area (Theobald and Romme 2007). More than 65 percent of the WUI is in wildland vegetation types that are classified as high hazard for wildfire (Theobald and Romme 2007). The aggressive, and often dangerous, actions used to protect homes and communities in the WUI from wildfire are stimulated by public perception and expectations, significantly inflating suppression costs (Calkin et al. 2014; Steelman 2016).

Fire suppression accounts for almost 60 percent of the U.S. Forest Service (hereinafter referred to as Forest Service) budget, totaling more than $2.4 billion in 2017 (see fs.fed.us). The current formula for determining appropriations for wildfire management, including suppression efforts, has resulted in underfunding since 2000 (Steelman 2016). When wildland fire suppression costs exceed the appropriated amount and any other available balances, the Forest Service must receive supplemental funding through fire transfers from other non-suppression accounts and programs within the agency (USFS Budget Justification 2015). Also known as fire borrowing, this process affects the ability of the program being borrowed from to effectively) carry out its mission, such as fuels reduction or restoration efforts (Steelman and Burke 2007). A new fire funding process was passed in the 2018 Appropriations Bill and promises to solve the fire borrowing problem, but it will not be in effect until 2020, making its success unknown at this point. This funding fix will establish a fund of more than $2 billion a year that would be available when costs of wildfires exceed the 10-year average, which will be set at the 2015 level, effectively limiting the amount of funds borrowed from non-fire Forest Service programs.

Barriers to solving the fire funding problem, beyond cost, include public perception, liability concerns, and thinning and burning limitations. Public and political pressure impose

constraints on an agency to minimize short-term risk and resource loss through suppression (Stephens et al. 2016). Public objections to smoke and concern for casualty and property risk limit the agencies from using prescribed burning (North et al. 2015; Stephens et al. 2016). North et al. (2015) argue costs and injuries are much lower on a prescribed or managed fire than on an escaped fire. Air-quality regulations are also said to limit some use of prescribed burning, although negative impacts to the airshed are much lower compared to an unmanaged wildfire (North et al. 2015; Stephens et al. 2016). Air quality concerns aside, weather and available personnel can limit periods for burning operations to as little as a single week of permitted burning time annually (Stephens and Ruth 2005). Such constraints to prescribed burning, although it is often a more economically and ecologically friendly fuels management technique when compared to mechanical thinning, make its use at a large-enough scale unlikely. Mechanically treating at large scales can be costly, particularly when the objective is to remove many small, low value trees of which there is little market for, as is the case in Colorado. Additionally, treatments may need to occur over many years with no impact from fire (Stephens et al. 2016).

Ecological restoration has often been discussed as the solution to declining forest health and a necessary accompaniment to a change in the suppression funding structure. Restoration efforts in frequent-fire forests largely involve fuel reduction treatments, either through burning or mechanical thinning (Covington and Vosick 2016). The literature suggests ecologically beneficial fire and a "significant expansion" of mechanical treatments are needed to achieve long-term resilience and restored ecosystems (Stephens et al. 2016; North et al. 2015). Much of the literature also encourages the coupling of fuel reduction and an increase in public-private collaboration as a sufficient solution to the wildfire paradox (Stephens et al. 2016; Steelman and

Burke 2007; Stephens and Ruth 2005). The WUI is dominated by private land ownership, and it is unlikely that private landowners will be able to address treatment priorities without some re-allocation of public funds (Theobald and Romme 2007). Stephens et al. (2016) recommend forest restoration, in areas of high priority like the WUI, be a stand-alone objective incentivized through agency regulations and planning documents. An important question now is how to incentivize such a costly endeavor and how to prioritize funding should it be reallocated.

1.2 Summary and Research Questions

In summary, wildfire costs are increasing, and the need to effectively address and prioritize this ecological issue is clear. The literature encourages fuel reduction and an increase in public-private collaboration as a sufficient solution to the wildfire paradox (Stephens et al. 2016; Steelman and Burke 2007; Stephens and Ruth 2005). Stephens et al. (2016) recommend the prioritization of restoration in the WUI be a stand-alone objective incentivized through public funds, agency regulations, and planning documents, as it is unlikely that private landowners will be able to address treatment priorities without support (Theobald and Romme 2007). To inform the prioritization of funding, it is necessary to demonstrate the costs of wildfires that burn in a residential forest as compared to those that burns in a wilderness area with little to no human component.

With climate change conditions and high forest fuel loads, Colorado remains at risk to burn at high intensity, as it has in the previous two decades (Donovan and Brown 2007; Omi and Martinson 2004; Mackes et al. 2007; Steelman 2016). The significance of undervaluing fire cost was recognized by some in the early 2000s but has experienced little additional research over the past decade. Much of the major research concerning the true costs of Colorado wildfires has not

been updated, including data from the 2000 Bobcat Gulch Fire, 2002 Hayman Fire, and 2002 Missionary Ridge Fire (Mackes et al. 2007; Lynch 2004).

This study reviewed the 2002 Hayman Fire, 2013 Black Forest Fire, and 2013 West Fork Complex Fire with the objective of identifying the true costs of these wildfires and the factors that contribute to those costs. The purpose of this study was to determine actual costs of these select Colorado wildfires, filling the related research gap over the past decade, and providing a sound basis for future prioritization of treatment areas and development of community wildfire plans. This research evaluated the costs of these three fires, the factors that contribute to those cost, and how the fire costs may vary by forest and land use type. Finally, implications for land management agencies are discussed.

2. METHODS

2.1 Sampling

A full accounting of the cost of a large fire event considers both suppression and short-term costs, as well as complex, long-term costs. These costs include impacts to watershed, businesses, individuals, ecosystems, communities, and government agencies that will be felt and continue to accrue for years, if not decades. In this study, the variability of costs was assessed in terms of forest and land use types associated with three high-intensity Colorado wildfires: the Hayman Fire, Black Forest Fire, and West Fork Complex Fire.

The fires sampled were suggested by Colorado State Forest Service leadership and represent a spectrum of ownership types. Each fire differs in location, severity, and cost, equating to a more complete body of research and allowing for comparison. While the West Fork fire burned primarily in wilderness area, the Black Forest fire occurred in the WUI with most acres

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being zoned as residential areas, and the Hayman fire burned on both National Forest and State and Private lands. Additionally, the West Fork Complex Fire burned in spruce-fir dominated forests, while ponderosa pine was the dominant forest type in the burn footprints of both the Hayman and Black Forest fires.

Lynch (2004) analyzed the Hayman Fire, Colorado's largest fire to date, and collected cost data for two years after the fire. A short-term, case study analysis was also conducted by the Forest Service for the Hayman fire (Graham 2003). To understand the true costs of a catastrophic fire event, research past the two-year mark must be conducted, as additional costs will have continued to accrue. This study builds upon the work already conducted on the Hayman fire to discover the indirect costs that have accrued since 2004 and accounts for the inflation that has occurred since 2004. According to the Bureau of Labor Statistics consumer price index (CPI), the CPI in 2004 was 188.9, and the CPI in 2018 was 249.554, representing a significant inflation rate. A standard inflation calculation was used to determine 2018 values (*Figure 1.1*).

$$\frac{CPI\ in\ 2018}{CPI\ in\ 2004} * 2004\ USD\ value = 2018\ USD\ value$$

Figure 1.1 Inflation Calculation

2.2 Data Collection and Analysis

Quantitative data was compiled from archived written reports, public documents, news articles, and budget sheets created by various federal, state and local agencies. To acquire those costs not documented or publicly available, county entities, federal employees, business owners, and other key informants were contacted, either by phone or email. Sources for each data point can be found in Appendix A. When cost data was acquired, it was organized in a master

spreadsheet, which included the informant or source of information and how the information was obtained.

This research involved an investigative, cyclical approach in which data was returned to throughout the data collection process, to check for accuracy and fill in gaps when possible. This study attempted to quantify losses in terms of dollars whenever possible. If a loss was found to be unquantifiable or unknown, it was discussed as such and left out of final cost estimates.

Fire costs were separated into three categories: direct, rehabilitation, indirect. These categories were developed and used by Lynch in his Hayman fire study (Lynch 2004). This study defined direct costs as those that occurred during the fire and included suppression and containment, property losses, law enforcement, and additional aid costs. Rehabilitation costs included expenditures by both private and government agencies, as well as post-event treatment by agencies and landowners. Indirect costs were defined as those costs that accrued after the fire and included factors such as tax losses, business and employment losses, lost recreation fees, water treatment costs, road damage, and flooding damage. Special value costs were included in the original Lynch study and included costs such as loss of life, effects on wilderness area, and resulting health impacts. However, it was determined that some value losses, such as loss of life, were outside the scope of the study, while others, such as lost habitat, were not considered because the loss was not permanent. Special values were, therefore, not included in this study.

The three cost categories were totaled and then divided into per-acre costs. These per-acre costs were compared across land use and ownership type. Percentages of suppression costs in relation to total costs of each fire were also calculated. Triangulation was used when testing the validity of the quantitative data gathered. Numbers reported by a given entity or individual were checked against the media, key informant speculation, or numbers or costs for a similar

circumstance whenever possible. However, all cost data and totals should be considered estimations.

3. RESULTS & DISCUSSION

Findings from this study reveal the costs of all three Colorado fires to be much higher than costs originally reported to the public. By including information gleaned through qualitative techniques, additional costs were discovered. The direct costs of each fire account for a significant portion of the overall costs; property losses and suppression accounted for much of direct cost totals. Rehabilitation costs were significantly higher for the Hayman fire, likely because the area has had more than a decade of recovery time. Indirect costs accounted for just three to six percent of overall costs for these three fires.

The costs associated with the Hayman fire totaled $311,677,586, a value $250 million more than the suppression costs of the fire and more than $60 million higher than the costs reported by the original study by Lynch (2004) with costs accruing far beyond the first few years after the fire (*Table 1.1*). As the indirect and rehabilitation costs for the Hayman fire have been demonstrated to continue accruing more than a decade after the fire, it is prudent to anticipate similar costs will accrue as a result of the Black Forest fire and West Fork Complex fire years to come. Direct costs accounted for more than 57 percent of the total cost of the Hayman fire. Suppression and containment totals accounted for 18 percent of the Hayman fire. The property losses, both insured and uninsured, for the Hayman fire accounted for 38 percent of the total fire costs (*Table 1.1*). More than $112 million in rehabilitation costs can be attributed to the Hayman fire, most of which is associated with general rehabilitation and the recovery of a damaged watershed (*Table 1.1*). The total expenses of watershed treatment to date exceed 33 million, but

Denver Water reported 147 million in total damages to Strontia Springs because of both the Hayman and Buffalo Creek fires. That figure is the amount it would cost to successfully dredge and restore that watershed, although Denver Water cannot take on this cost and will not be conducting such restoration activities. Denver Water has not quantified other costs associated with staff time, planning, or permitting in reacting to the Hayman fire. The original study of the Hayman fire estimated a 10 to 70 percent reduction of value of surviving structure for the year following the fire (Lynch 2004). It was concluded that no fire-related appeals to counties were received after 2004, and thus, no further losses were incurred. The business losses associated with the Hayman fire included losses from campground and ranch closures and negative impacts to the fishing industry. Tax revenue losses were seen in the first two years after the Hayman fire. Flood damages to private property because of the Hayman fire were said to be as high as $14 million by individuals from the Coalition for the Upper South Platte, but this study could only account for about $2 million in damage.

Table 1.1: Hayman Fire Cost Breakdown

Cost Type	2004 Study	Inflated 2004 Cost Value	2018 Study	Cost Per Acre	Percent Total
Direct Costs					
Suppression	$ 43,294,741.00	$ 57,196,272.08		$ 415.19	18.35%
Insured Property Loss	$ 38,700,000.00	$ 51,126,203.28		$ 371.13	16.40%
Uninsured Property Loss	$ 51,936,600.00	$ 68,612,950.11		$ 498.07	22.01%
Evacuation Costs	$ 765,940.00	$ 1,011,876.08		$ 7.35	0.32%
FEMA Grants	$ 851,552.00	$ 1,124,977.28		$ 8.17	0.36%
Direct Cost Total	$ 135,548,833.00	$ 179,072,278.83	$ -	$ 1,299.90	57.45%
Rehabilitation Costs					
Recovery/Rehabilitation	$ 43,319,772.00	$ 57,229,340.29	$ 4,871,410.00	$ 450.79	19.92%
Watershed Damages and Dredging Costs	$ 3,850,000.00	$ 5,086,198.52	$ 28,100,000.00	$ 240.90	10.65%
USGS Mapping	$ 240,000.00	$ 317,061.73		$ 2.30	0.10%
Coalition for the Upper South Platte	$ 518,200.00	$ 684,589.11	$ 16,300,000.00	$ 123.29	5.45%
Rehabilitation Cost Total	$ 47,927,972.00	$ 63,317,189.65	$ 49,271,410.00	$ 817.29	36.12%
Indirect Costs					
Tax Revenue Losses	$ 676,266.00	$ 893,408.60		$ 6.49	0.29%
Business Losses	$ 2,918,000.00	$ 3,854,942.15	$ 4,333,600.00	$ 59.44	2.63%
Forest Service Recreation Fees	$ 60,250.00	$ 79,595.70		$ 0.58	0.03%
Flood Damages	$ 1,540,608.00	$ 2,035,282.63	$ 8,819,878.00	$ 78.80	3.48%
Indirect Cost Total	$ 5,195,124.00	$ 6,863,229.09	$ 13,153,478.00	$ 145.30	6.42%
True Cost of the Hayman Fire	$ 311,677,585.56				
True Cost Per Acre	$ 2,262.48				

Table 1.2: West Fork Complex Fire Cost Breakdown

Cost Type	Total Estimated Cost	Cost Per Acre	Percent Total
Direct Costs			
Suppression $	33,200,000.00	$ 302.88	50.355%
Evacuation Costs $	125,942.00	$ 1.15	0.191%
Timber Loss $	19,083,102.00	$ 174.09	28.944%
FEMA Support $	7,939,303.00	$ 72.43	12.042%
Direct Cost Total $	**60,348,347.00**	**$ 550.55**	**91.531%**
Rehabilitation Costs			
Road Reconstruction $	394,358.00	$ 3.60	0.598%
Planting/Restoration $	420,481.00	$ 3.84	0.638%
Watershed Recovery $	364,500.00	$ 3.33	0.553%
Trail Closures $	58,814.00	$ 0.54	0.089%
BAER Funding $	574,049.00	$ 5.24	0.871%
Monitoring $	3,600.00	$ 0.03	0.005%
Rehabilitation Cost Total $	**1,815,802.00**	**$ 16.57**	**2.754%**
Indirect Costs			
Business Losses $	650,000.00	$ 5.93	0.986%
Flood Damage $	3,000.00	$ 0.03	0.005%
Grazing Allotment Damages $	66,084.00	$ 0.60	0.100%
Marketing for Economic Recovery $	355,000.00	$ 3.24	0.538%
Forest Plan and Community Plan Updates $	193,750.00	$ 1.77	0.294%
Improved Emergency Notification Efforts $	2,500,000.00	$ 22.81	3.792%
Indirect Cost Total $	**3,767,834.00**	**$ 34.37**	**5.715%**
True Cost of the West Fork Complex Fire $	**65,931,983.00**		
True Cost Per Acre $	**601.49**		

Table 1.3: Black Forest Fire Cost Breakdown

Cost Type	Total Estimated Cost	Cost Per Acre	Percent Total
Direct Costs			
Suppression $	9,230,000.00	$ 646.36	1.755%
Insured Property Loss $	420,500,000.00	$ 29,446.78	79.970%
Uninsured Property Loss $	38,686,000.00	$ 2,709.10	7.357%
Value of Trees Lost $	29,920,862.00	$ 2,095.30	5.690%
FEMA Support $	6,617,742.00	$ 463.43	1.259%
Direct Cost Total $	**504,954,604.00**	**$ 35,360.97**	**96.031%**
Rehabilitation Costs			
Thinning of Burned Timber $	1,137,500.00	$ 79.66	0.216%
Planting/Restoration $	1,875,883.00	$ 131.36	0.357%
Black Forest Together (volunteer time, expenses, rehabilitation, grants) $	1,702,890.00	$ 119.25	0.324%
Coalition for the Upper South Platte $	10,000.00	$ 0.70	0.002%
Rehabilitation Cost Total $	**4,726,273.00**	**$ 330.97**	**0.899%**
Indirect Costs			
Mental Health Grants $	282,615.00	$ 19.79	0.054%
Tax Losses to El Paso County $	43,430.00	$ 3.04	0.008%
Flood Mitigation/Recovery Costs to County $	15,736,562.00	$ 1,102.00	2.993%
Updates to Community Wildfire Protection Plan $	80,000.00	$ 5.60	0.015%
Indirect Cost Total $	**16,142,607.00**	**$ 1,130.43**	**3.070%**
True Cost of the Black Forest Fire $	**525,823,484.00**		
True Cost Per Acre $	**36,822.37**		

The costs associated with the West Fork Complex fire totaled $65,931,983, almost $35 million higher than the fire cost review conducted by the U.S. Forest Service (USFS) in 2014 (*Table 1.2*). Direct costs accounted for more than 90 percent of the total costs of the West Fork Complex fire. Suppression and containment totals accounted for 50 percent of the West Fork Complex fire (*Table 1.2*). As the West Fork Complex fire burned primarily on wilderness and public lands, there was little human component and no property losses were experienced. This lack of human component is a major factor in the low overall cost of the West Fork Complex fire in comparison to the other two fires. Rehabilitation costs associated with the West Fork Complex fire are relatively minimal, as were watershed damages. Flood damages resulting from the West Fork Complex fire were also investigated and found to be minimal, which hydrologists in the area attributed to few rain events following the fire. The sales tax revenue for the towns surrounding the West Fork Complex were trending down before the fire due to other factors, so those losses were not included in this study. The Pagosa Springs Chamber of Commerce could not say if there was a negative impact to recreation or tourism in the area because of the fire, as hotels and restaurants had average to high business during that time.

The costs associated with the Black Forest fire totaled $525,823,484, about $96 million higher than the suppression costs and insured property losses reported for the fire (*Table 1.3*). Direct costs accounted for more than 90 percent of the total costs of the Black Forest fire (*Table 1.3*). The Black Forest fire burned less than 15,000 acres, while the other two fires each burned more than 100,000 acres. Suppression and containment totals accounted for 2 percent of the Black Forest fire. The cost associated with evacuating 38,000 individuals during the Black Forest fire and law enforcement used during that time could not be determined, which would increase those costs further. The property losses, both insured and uninsured, for the Black Forest fire

accounted for 87 percent of the total fire costs (*Table 1.3*). Rehabilitation costs were found to be relatively low for the West Fork Complex fire and the Black Forest fire, although both burn areas have been undergoing rehabilitation activities for less than five years, while the Hayman burn scar has had more than a decade of recovery activity. The severity or costs associated with watershed damage and treatment costs resulting from the Black Forest fire could not be determined, although recovery costs associated with flooding damage were found. The Black Forest fire resulted in almost $16 million in mitigation and recovery costs from flooding events after the fire, as reported by El Paso County (*Table 1.3*). Although, a major disaster declaration for Colorado on September 14, 2013 was signed by President Obama for El Paso County and 10 other counties that received individual assistance. On the same day, Governor Hickenlooper signed Executive Order D 2013-26 declaring a Disaster Emergency due to the flooding and ordered that $6 million be transferred into the State's Disaster Emergency Fund. It was not clear what amount of that $6 million was awarded to El Paso County. According to El Paso County officials, a treeless lot currently sells for about 30 percent less than one with pristine trees, and buyers will pay about 15 percent less for a lot with damaged trees. This reduction in value was not quantified in this study.

Special values were not determined in this study but were included in Dr. Lynch's original study of the Hayman fire costs (2004). While two deaths resulted from the Black Forest fire, no attempt was made to account for the value of human life in this study. Additional special value losses for the Hayman fire to build on the original study were investigated. Large values were placed on the loss of endangered butterfly habitat in the original study, but it appears these butterfly populations began recovering in 2008, so this study attributes no permanent loss or further cost to this event regarding butterfly habitat. A recent study found 40 percent of sites

within the Hayman fire area surveyed to be showing abundant regeneration, likely due to its

exposure to summer monsoonal rains (Rother and Veblen 2016). According to USFS trailhead

data, 2002 and 2003 had reduced use levels in the wilderness and roadless areas within the

Hayman fire footprint, but usage of those areas has been increasing since that time. Some of

these areas, like Goose Creek trailhead are seeing use levels above what they were pre-fire; no

additional losses associated with damage to wilderness or roadless areas were included in this

study and were determined to be non-permanent.

4. CONCLUSION

It is clear the effects of humans on the landscape increase the costs of a wildfire

dramatically. The differentiation between these three fires can best be seen in the per-acre costs.

A fire event on public land or in wilderness areas, like the West Fork Complex fire, does not

have the same values at risk as a fire event that impacts human values. The Hayman fire occurred

both in the WUI and on public lands with wilderness and roadless areas, while the Black Forest

fire occurred completely in a residential area within a forested landscape. The per-acre cost for

the West Fork Complex fire just exceeds $600. The per-acre cost for the Hayman fire is

estimated to be $2,262, and estimates for the Black Forest fire are $36,822 per acre. With

treatment cost averaging between $1,500 and $2,500 per acre, the per-acre costs of the Black

Forest fire far exceed what it would have cost to treat or restore those same acres before the fire,

potentially reducing the risk of that fire occurring (Jones et al. 2017). On the other end of the

spectrum, the per-acre cost of the West Fork Complex fire is likely less than any preventative

measure would have cost.

Stephens et al. (2016) suggest forest restoration and the prioritization of funding for such must occur in areas of high priority and high cost risk. This study affirms that suggestion by demonstrating the cost differentiation between a wildfire that burned in a residential forest with a significant human component as compared to one that burns in a wilderness area with no human component. While the Hayman fire burned on both public and private lands, an important watershed was damaged, which is considered a high-value human component and attributed to the high costs of this fire. This study presents evidence suggesting the prioritization of funding and management should likely occur where the greatest human components and highest cost risks reside. As private landowners do not likely have the resources to address these treatment priorities, some reallocation of public funds will be necessary to facilitate fuel reduction and public-private collaboration to sufficiently address the wildfire paradox (Stephens et al. 2016; Steelman and Burke 2007; Stephens and Ruth 2005).

A limitation of this research study is the reliance on estimations and information collected and determined by others. It was often difficult to validate each data point or value, and apart from the full analysis conducted to determine the timber value loss resulting from the West Fork Complex fire, they were compiled as provided and existing information was gathered from many sources to best-depict the true cost of these fires. In some instances, data points and values pursued were not always available, which also impacts the accuracy of this study. For example, an accurate value of restoration activities being conducted by individual landowners within the Black Forest fire footprint was not accounted for in this study. This value will require further research and depend on the length of time it took to remove burned timber after the fire and the opportunity for getting products out of the timber to reduce removal costs. To more accurately represent the costs associated with these three wildfires and fires studied in the future, it will be

important for researchers to conduct individual analysis on each data point instead of relying on estimations from outside sources.

Several assumptions were made in this study. This study does not account for any of the benefits associated with wildfire, like additional jobs and greater ecological resilience. This study also suggests fuel reduction can reduce fire cost; while there is some evidence to suggest this, especially if the fuel reduction is coordinated across the landscape, that evidence is limited and suggests fuel reductions do not stop wildfire, but change behavior of those fires (Calkin et al. 2014). Finally, Congress is more likely to fund emergencies, rather than be proactive in preventing them, so it is important to be able to anticipate and prioritize areas where potential costs could be highest as funds will be limited.

Our research investigated the complete cost assessments for three different fires in three different land use and ownership types to better understand the financial impact of wildfire and relative benefit of preventative measures across different landscape and ownership contexts. A future study could use cost data from this study and similar outside studies to preform statistical analysis and estimate the numerical differentiation of wildfires that occur on different land use and ownership types to further inform the prioritization of management and funding.

CHAPTER TWO

POLICY APPROACHES TO SUPPORT RESTORATION AND FIRE PREPAREDNESS
ACROSS PUBLIC AND PRIVATE LANDS: AN EVALUATION OF THE JOINT CHIEFS'
LANDSCAPE RESTORATION PARTNERSHIP

1. INTRODUCTION

Fire management requires that land managers work across the public-private boundary at
large enough scales to affect fire behavior (Agee and Skinner 2005; Theobald and Romme 2007;
Moritz et al. 2014). There is a mismatch between large-scale, dynamic, ecological processes, like
fire, and the scales at which individual land management agency units have the capacity and
authority to work. To improve governance and address such scalar mismatches, scholars across
disciplines emphasize the need to work across boundaries and at scales more aligned with
ecological processes (Cash et al. 2006, Kettl 2006, Folke et al. 2007 Cumming et al. 2012). A
prominent and important question now is how to design policy and authorities that resolve scale
mismatch and support collaborative management across jurisdictional boundaries to produce
improved outcomes.

The broader environmental governance literature emphasizes that collective action and
collaboration are valuable for working across boundaries and at larger and multiple scales (Folke
et al. 2005). In US forest management, as part of a growing demand by community-based groups
for more participatory processes to find place-based agreements, collaborative approaches have
become increasingly institutionalized, with non-state actors participating in and contributing
funding to land management planning and implementation (McCarthy 2005, Schultz et al. 2012,
Maier and Abrams 2018). The Forest Service has developed multiple tools and authorities to

improve management to address ecological challenges like restoration, through the use of collaboration and other approaches to improve the pace and scale of planning (USFS 2015).

The Joint Chiefs Landscape Restoration Partnership was the most recent policy tool to address fire hazard by focusing on a then-unfunded challenge in fire management: working at larger scales across the public-private jurisdictional divide. The Joint Chiefs Partnership is a multi-year partnership, established in 2014, between the Forest Service and Natural Resource Conservation Service (NRCS), and extends nation-wide. Potential project areas submit proposals, and if selected, are awarded three years of committed funding, dependent on project type and size. The Joint Chiefs Partnership attempts to address scalar mismatch and the wildfire problem through this committed, long-term funding and through the requirement to coordinate across boundaries through interagency and stakeholder collaboration. Projects must prioritize adjacent lands at the public-private boundary and address wildfire risk, wildlife habitat, or watershed health. Joint Chiefs projects are required to provide annual progress reports and a final report of overall accomplishments. Investments to date exceed $60 million in 49 projects across the nation (*Figure 2.1*).
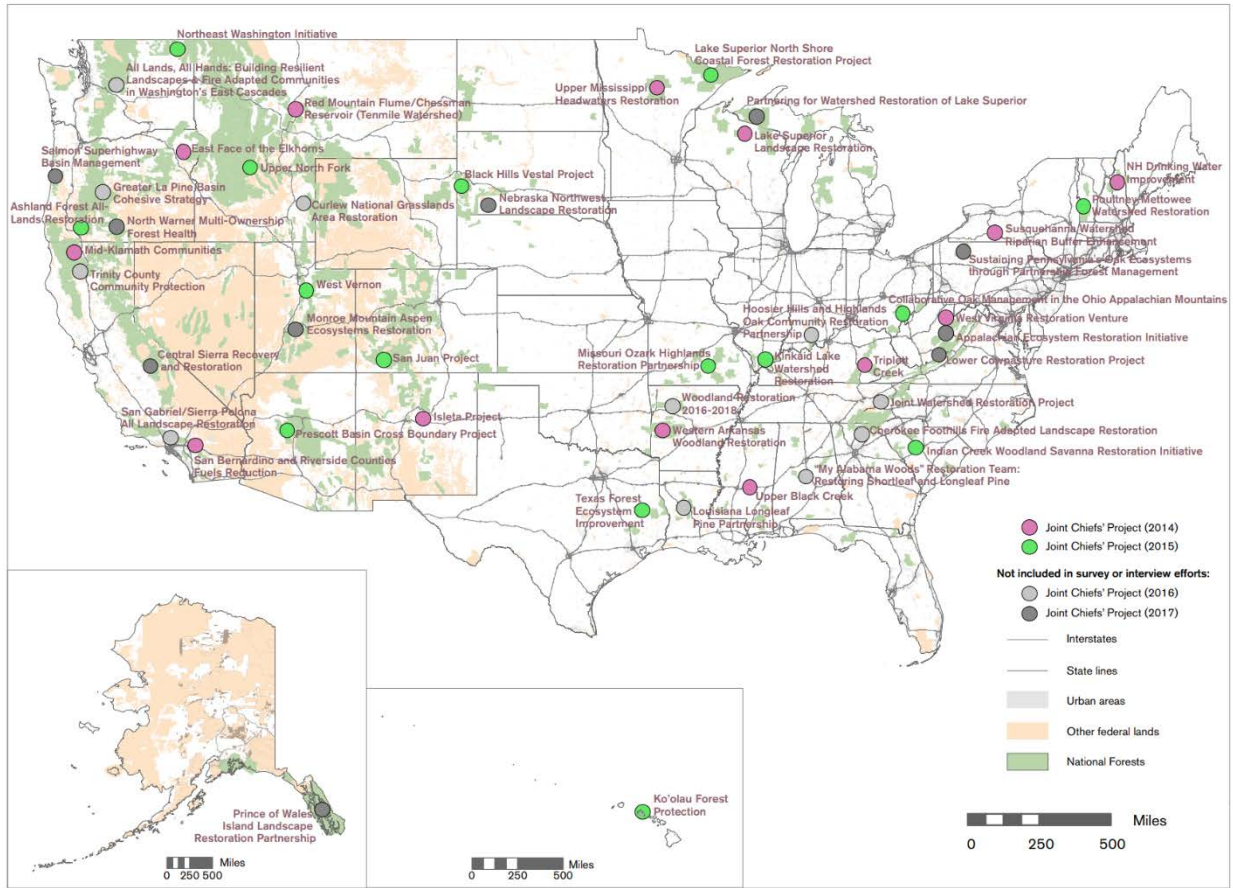
Figure 2.1 Joint Chiefs Partnership Projects Map

In order to contribute to the literature on policy design to improve environmental governance, we examined the Joint Chiefs Partnership as an innovative policy tool meant to overcome long-standing challenges in forest management by improving the scales of planning and implementation through collaboration and multi-year funding commitments. In this paper, we focus on two research objectives: 1) understanding how the design of the Joint Chiefs Partnership supported progress in accomplishing cross-boundary work, and 2) identifying the underlying conditions that either helped or hindered the ability of project participants to undertake cross-boundary work. Our goal is to contribute an empirical review of a large-scale,

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collaborative, cross-jurisdictional authority to inform understandings of policy design to address the challenges of planning at a large enough spatial extent to tackle problems like fire management that require cross-boundary, collaborative efforts.

2. LITERATURE REVIEW

2.1 The Fire Management Challenge in the West

Across much of the Western United States, average fire season length, number of large fires, and annual area burned are increasing (Calkin et al. 2014; Stephens et al. 2016). Increased density of shade-tolerant trees, dead fuel accumulations, fuel continuity, and climate change have caused a rise in high-severity wildfires in the United States, or those that have large footprints and cause loss of life and property (Donovan and Brown 2007; Omi and Martinson 2004; Steelman 2016). Forest managers have struggled to implement effective fuel reduction and forest ecosystem restoration treatments to address these issues, and there has been a deficit of action particularly at the intersection of public and private lands (Schoennagel et al. 2009, 2017). Addressing these challenges will require more natural fire use and other fuel reduction strategies, like mechanical thinning and prescribed fire, to reduce hazardous fuel build-up (Steelman 2016; Stephens et al. 2016; Seielstad 2015).

The potential for use of natural fire to reduce fuel loads is limited because of the increased need for suppression as populations grow and the Wildland-Urban Interface (WUI) expands (Calkin et al. 2014; Stephens et al. 2016). The WUI, most simply, includes areas of human development that intermingle with wildlands (Reilly 2015). The presence of a WUI exacerbates the wildfire paradox, whereby suppression today only leads to a greater need for and cost of suppression in the future, as special efforts are often made to protect homes and property

values (Reinhardt et al. 2008; Gorte 2013). The WUI has expanded to more than 12.5 million housing units as of 2000, an increase of 52 percent, since 1970 (Theobald and Romme 2007). It is estimated that the WUI will continue to expand, particularly in the Intermountain West area (Theobald and Romme 2007). More than 65 percent of the WUI is in wildland vegetation types classified as high hazard for wildfire (Theobald and Romme 2007). As the WUI continues to expand, so does the need to work across the public-private boundary and engage private landowners to create defensible space and address fuel loads where the goal is to reduce fire hazard (Schoennagel et al. 2017). System processes, like wildfire, will continue to threaten life and property if land managers cannot work across the public-private boundary at large enough scales to reduce fuel loads in a way that will affect fire hazard (Agee and Skinner 2005; Theobald and Romme 2007; Moritz et al. 2014).

2.2 Governance Design for Cross-Boundary Work

Addressing fire and other large-scale ecological processes through Forest Service management and policy is a major governance challenge and requires work across jurisdictions and with communities. Managers encounter a mismatch between the scales of ecological processes and the scales at which individual land management agency units can work, particularly for addressing issues like wildfire, watershed health, and biodiversity conservation. To improve environmental governance, scholars across disciplines emphasize the need to work across boundaries (e.g. across jurisdictions, agency units, or broader social and epistemological boundaries) and at scales more aligned with ecological processes, which requires planning beyond traditional federal management units and boundaries (Folke et al. 2007, Cash et al. 2006, Kettl 2006, Cumming et al. 2012). This challenge is part of a broader trend in U.S. public administration, whereby today's challenges require greater interorganizational coordination and

networking among public and private sectors to address multi-sectoral, complex problems (Kettl 2006). The failure to address scalar mismatch and work across boundaries often leads to mismanagement of ecosystems, reducing system resilience and causing environmental degradation (Cumming et al. 2006, Folke et al. 2007, Cash et al. 2006, Kettl 2006, Cumming et al. 2012).

The broader environmental governance literature emphasizes that collective action and collaboration are valuable for working across boundaries and at larger and multiple scales (Folke et al. 2005). The need for greater collective action and collaborative approaches has become increasingly institutionalized in U.S. forest management, with non-state actors participating in and contributing funding to land management planning and implementation (McCarthy 2005, Schultz et al. 2012, Maier and Abrams 2018). Collaboration can be defined as "a process in which autonomous actors interact through formal and informal negotiation, jointly creating rules and structures governing their relationships and ways to act or decide on the issues that brought them together; it is a process involving shared norms and mutually beneficial interactions" (Thomson and Perry 2006). A collaborative, all-lands or cross-boundary approach can improve management and planning efficiencies while addressing scalar mismatch, creating space for stakeholder involvement and support, and supporting networking across actors and boundaries to design and implement governance solutions (Folke et al. 2007; Cash et al. 2006, Kark et al. 2015). Scholars highlight the value of co-management, which involves some degree of power sharing between state and non-state actors to promote local solutions, learning, and collective action (Berkes 2009, Huitema et al. 2009).

A prominent and important question now is how to design policy that resolves scale mismatch and supports collaborative management across jurisdictional boundaries to produce

improved outcomes, which might include more effective and coordinated management actions, improved approaches to planning, and greater collective action. Decaro et al. (2017) propose policy design principles to support adaptive governance approaches that allow for scale flexibility, learning, and collaboration. Much of the literature supports the embrace of non-state actors as part of the resource management process to leverage resources and work across boundaries; to do this, scholars suggest a need for flexible authorities with broad goals that leave space for tailoring specific implementation strategies to local contexts (Craig et al. 2017, Cumming et al. 2012). Innes and Booher (2003) contend that "the way to build societal and institutional capacity, and the learning processes that are essential to them, is through collaborative planning and action," which in the U.S. context requires specific policy tools that create space for collaboration in a state-dominated system. Tangible support at the national, state, and local levels in the form of resources, information and training are also important (Decaro et al. 2017).

The policy design literature also emphasizes the importance of bridging structures. Boundary organizations or bridging structures serve as trusted liaisons among different centers of activity or knowledge, supporting networks and partnerships by facilitating communication and mediating differences (Cash et al. 2003, Decaro et al. 2017, Abrams et al. 2017a). Organizations that overlap in terms of responsibilities but work at different levels can work together with complementary expertise to address components of scalar mismatch (Cash et al. 2003, Cumming et al. 2012). Involving multiple actors also allows for social learning and co-production of planning, potentially transforming attitudes and fueling motivations (Cash et al. 2003, Cumming et al. 2012). However, when operating at large scales and working with many stakeholders or government organizations, it is difficult to build consensus or agree upon a unified vision. This is

especially true when working within agency cultures and capacities (Kettl 2006). In the absence of these bridging structures and linkages, poor coordination and conflict may arise (Kettl 2006).

While many governance scholars and ecologists advocate for such an approach, agencies face a growing array of obstacles in landscape and cross-boundary management (Cash et al. 2006, Folke et al. 2005, Kettl 2006). An enduring challenge has been finding a place for collaboration within existing legal mandates, like the National Environmental Policy Act and National Forest Management Act (Klyza and Sousa 2008). Such mandates place decision-making authority entirely with a given federal agency and limit influence or space for non-agency actors or stakeholders. Sharing responsibility involves some surrender of authority and poses accountability issues, which is daunting for any public agency (Kettl 2006). The fundamental tension and challenge with governance adaptation lies in allowing flexibility and co-management of federal lands within a legal system designed to limit the influence of outside actors.

However, given the complexity of current challenges, agencies now must manage their own programs as well as connect with other closely related programs and entities, making an organization's success increasingly dependent on its ability to work with others (Kettl 2006). In the context of land management, work at large scales necessitates work across boundaries and increases the likelihood of involving and affecting multiple actors, including multiple public agencies and non-state entities. Many actors mean greater potential for conflict and power imbalance, but also increased potential for collective action (DeCaro et al. 2017, Bryson and Crosby 2006). A particular challenge in the federal lands context, when attempting to work across the public-private boundary may be lack of participation from private landowners, lack of access to these individuals through standard agency channels, and distrust of the federal

government. Lack of participation across the private boundary can make collaboration difficult. In sum, cross-boundary work will stretch the expertise of any one agency and force collaboration and partnerships, which brings both opportunities and challenges.

When evaluating effectiveness of a policy design to support cross-boundary or landscape work, the following must be assessed: embrace of non-state actors and collaboration (Craig et al. 2017; Cumming et al. 2012), support of planning and implementation across jurisdictions (Folke et al. 2007; Cash et al. 2006), flexibility and space for local goals and contexts (Decaro et al. 2017), promotion of learning (Innes and Booher 2003), and an ability to fit within the existing legal structure (Klyza and Sousa 2008). We expect that policies with tangible support for implementation, clear roles for multiple parties, and flexible mandates, with stable support but room to tailor approaches locally, will support cross-boundary efforts. From the literature, we expect factors such as established relationships, use of bridging structures, supportive leadership, and sufficient capacity to be facilitators. We expect landowner distrust, agency inertia, interagency cultural differences, and lack of capacity and coordination to limit success.

3. METHODS AND RESEARCH QUESTIONS

Our goals were to understand in what ways the Joint Chiefs Partnership tackled the challenge of working across the public-private boundary to improve ecological conditions. Our research focused on two primary questions: 1) What aspects of the design of the authority supported progress in accomplishing cross-boundary work? 2) What other factors helped or hindered efforts to work across boundaries?

We took a pragmatic and qualitative approach to answering these questions, as they required capturing the perspective of Joint Chiefs Partnership participants to understand the

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contextual and emerging conditions of each project and the program as a whole (Yin 2015). We

conducted semi-structured interviews to glean contextual conditions of each project and

understand the Joint Chiefs Partnership initiative from the perspective of each participant (Yin

2015). We interviewed participants from 17 Joint Chiefs Partnership projects, sampled from the

28 that were awarded funding in 2014 and 2015 (*Figure 2.1*). Sampled projects included eight

projects from fiscal year '14 and nine projects from fiscal year '15. We focused on 2014 and

2015 projects because these would have more time on the ground to identify lessons learned. We

omitted 2016 and 2017 awarded projects due to the short timeline of these projects; 2016

projects were awarded funding less than one year prior to our study and we wanted informants

who had adequate time during active projects to answer the interview questions.

　　With the help of the Washington Office, we identified project leads for these Joint Chiefs

Partnership projects. To identify additional participants, we started by contacting all Forest

Service and NRCS leads for interviews via email, and upon interviewing them, we asked for

recommendations of additional internal and external contacts with a strong knowledge of the

project. Our goal was to get program-wide perspective rather than conduct case studies. We

employed purposive sampling and aimed to interview one internal Forest Service staff, one

internal NRCS staff, and one external stakeholder per project to obtain diverse perspectives

regarding project success, challenges, and potential improvements to the program and its

administration (Patton 2015). Collecting evidence and perspective from a diversity of

participants allowed us to triangulate our data, increasing the credibility of our results (Yin

2015). Solicitation requests for interviews were emailed to participants twice with a final follow-

up call. In the event of no-response or negative response, we worked to identify another potential

candidate and solicit their participation. A potential bias in our approach is that we may not have

spoken to those least satisfied with the program, if this was a reason for their non-response or if those less-satisfied individuals were no longer participating with the Joint Chiefs Partnership project or were not recommended to us. Similarly, all Joint Chiefs Partnership projects were awarded funding and given priority in an area, which may contribute to the highly positive perspectives of this program as reported by participants.

We conducted hour-long interviews in-person or over the phone. We completed 62 semi-structured interviews, including 21 with Forest Service staff, 19 with NRCS staff, and 22 with external partners. Topics discussed included successes of the partnership, project innovations, collaborative efforts, institutional barriers and challenges, and what participants felt needed to change going forward. For example, we asked "What do you feel are the greatest facilitators of any progress your project has made? How have those factors helped your project succeed?" and "Have you worked with groups or partnerships outside of your project to advocate for your project in terms of money, time, communication, knowledge, or staffing?" A full interview guide can be found in Appendix B. All interviews were recorded and then transcribed, following confidentiality procedures approved by CSU's Institutional Review Board.

We coded all interviews to support data analysis. Coding and memoing methods were derived from the grounded theory method developed by Corbin and Strauss (2014). All interviews were analyzed through coding in Dedoose, an online platform for qualitative researchers. We used codes to organize our data and identify emergent themes including successes, program value, challenges and barriers, future recommendations, and innovations. A more detailed discussion of our coding methods can be found in Appendix C. We reviewed transcripts and examined excerpts for individual codes, writing a memo for each code, which provided an additional analytical step for looking at all comments on a topic together at once.

4. RESULTS

We asked interviewees about the effectiveness of the policy design of the Joint Chiefs Partnership in terms of the engagement of multiple actors and ability to work across boundaries; we asked people specifically about the aspects of the policy that supported success in their view. We also evaluated the underlying conditions in project areas that affected project participants' ability to accomplish cross-boundary work. We address each of these two questions below and provide a table with supplemental quotations in support of our findings (*Table 2.1*).

4.1 Perspectives on the Joint Chiefs Policy Approach and its Effects

While there was no minimum acreage or scale requirement for projects, almost every project reported that the Joint Chiefs Partnership allowed them to increase the pace and scale of restoration activities. Funding reportedly allowed for greater pace, and scales were thought to be increased by including the private lands component, making for more contiguous treatment landscapes. Most interviewees said they were engaging in restoration at landscape scales more than in the past and more work on public and private lands was accomplished (*Table 2.1*). A Forest Service employee explained, "We have projects ready, we're just looking for funding and this has given us a great shot in the arm to get this project rolling and going." Another interviewee stated, "It helped us with both pace and scale, because like I said, we [treated] some pretty huge chunks of landscape, which is scale. Then the pace of the restoration, we only had three years to do it, so we were able to ramp up and match that pace and scale with the restoration."

The Joint Chiefs Partnership required interagency coordination and support from non-state actors as part of project proposals and implementation. As a result of this requirement, all projects engaged in new collaborations, and the most frequently reported success of the Joint

Chiefs Partnership was the strengthening of existing relationships or creation of new ones (*Table 2.1*). One Forest Service employee explained, "I think it helped build new relationships and facilitate some successes that we probably couldn't have had if we had just stayed in the same old stove pipes. So, it broke down barriers." Coordination was seen in terms of planning across jurisdictions, communication between partners, and some knowledge sharing. A majority of interviewees reported an increase in understanding between the Forest Service and NRCS regarding their processes, resources, and areas of expertise, which allowed for more resource sharing and cross-boundary coordination and implementation.

Our data suggest that with this increase in scale and improved partner coordination also came more opportunity to work across the public-private boundary (*Table 2.1*). As the Joint Chiefs Partnership required inter-agency and non-state collaboration, it allowed for some degree of permeability between the public and private boundary, as well as the internal boundary between the two agencies on most projects. A collaborative participant emphasized this point and said, "The Joint Chiefs' offered us the ability to do that cross-boundary work; to line up work on public lands with what we were doing on private lands areas. In that way, we have more of a landscape scale approach to protecting water and protecting our communities." Speaking to the cross-boundary component, a Forest Service employee stated, "To me the biggest value added with this is working across borders. We can do what we can do on Forest Service land but if there's not additional treatment done on private land it's kind of a moot point. The forest doesn't stop at an arbitrary political boundary and the work needs to be done across borders."

As a result of the collaborative requirement, our data suggest partners were used to stretch the capacity of their federal partners in terms of additional staff and expertise and in leveraging of their programs and additional funds. Most interviewees discussed the value of

working cooperatively to achieve more than any single entity could, as well as the importance of collaborative efforts when dealing with complex, large-scale problems (*Table 2.1*). Projects used tribal crews, private landowners, state agencies, collaborative stakeholder groups, and volunteers to get work done on the ground, which includes inventory, technical assistance, monitoring, and identification of priority landscapes. On one project, a tribal restoration crew provided both cultural and biological knowledge of the area, and added implementation capacity. As one Forest Service employee explained, projects leveraged the science, monitoring, and implementation capacity of local universities and groups like The Nature Conservancy; "We've used the Nature Conservancy as kind of our science basis. They actually hired a PhD ecologist that managed the monitoring program and helped us figure out what we need to monitor, how, and all of that. Then, when we developed the multi-party monitoring plan, we brought in, I guess experts in the field from the National Parks Service, Oregon State, and Southern Oregon University." The technical forestry capacity of NRCS was often reported as being expanded through trainings and implementation by the Forest Service, a state's forestry department or a NRCS forester from another area. One NRCS employee stated, "None of us is strong individually, but stronger together, and we can pull our staff resources, our technical resources, our financial resources together to make an impact."

Our data also indicate that the program built some collaborative capacity that will endure beyond project end-dates. The majority of participants reported that strengthening or establishing relationships would lead to some amount of future collaboration and cross-boundary work between the two agencies or with community partners (*Table 2.1*). Almost every participant reported they would like to continue working across the boundary with their partners in some capacity. As one external interviewee explained, "The only way we can move forward is in

unison, with each other, as a group." Several interviewees reported that they would continue partner relationships because those relationships are necessary to get work done or make their project proposals more competitive in the future.

The multi-year investments in projects were reported as essential to successfully incentivize partnerships and effect large-scale ecological conditions (*Table 2.1*). Both partners and landowners reportedly came to the table because of funding. A Forest Service participant explained, "A lot of landowners rely on that cost-share assistance like NRCS and Farm Service Agency and other agencies provide, so that's a big incentive to get landowners to do work that needs to be done across the landscape. Without that funding being available, it probably wouldn't get done on private lands." An external collaborative had a similar position, and stated, "[T]o put some money in the hands of some people who have some good ideas about how that can make a difference and incentivizing them to organize some projects, boy, that goes a long way. That encouraged people to look for partners, to be creative, to leverage ideas that individuals or program areas might have had for a while." About a quarter of interviewees suggested that once the funding was gone, so too would be the motivation and partnerships necessary to continue cross-boundary work. As an external partner emphasized, "All of this happened because of a funding source, and if the funding source goes away, then the motivation for maintaining partnerships is lessened." Reports of future maintenance and monitoring needs in these project areas were discussed by about a fifth of interviewees, the implementation of which will be difficult without additional Joint Chiefs Partnership funding.

4.2 Underlying Conditions: Facilitators and Barriers

According to our interview data, the most critical factor underlying effective cross-boundary work and project success was having established collaborative relationships. When

agencies were working with or were part of an established collaborative, coalition, partnership, or informal group of stakeholders, a higher degree of coordination and trust was reported by nearly every participant involved (*Table 2.1*). As one District Ranger noted, "I think if you were trying to start from scratch on the collaborative, and the first time you tried to get people together was around this funding, it may take you a lot longer to really start up and be effective and agree on the best approach." Those projects with partners that reportedly did not work well together often struggled with the new, cross-boundary approach. Established collaboratives or working groups with a track record of success often had greater degrees of credibility within a community and had systems in place to handle dissention or differences in opinion, should they occur.

Another major theme from interviews was that collaboratives, external partners, and some landowners acted as linkage institutions or individuals that provided trustworthy outreach and education to the public and other landowners. Non-federal partners were often involved in outreach when they had established trust or communication with landowners or more sophisticated outreach strategies than the Forest Service or NRCS. A project in Arizona used a partnership with the Center for National History to outreach to the public, which added credibility to the project and garnered community buy-in. As one Forest Service employee working on that project explained, "People trust them more than they trust us." One project saw a city-led community outreach strategy, which included engagement with local breweries to discuss the importance of the local watershed. Several interviewees involved in those projects using a linkage institution for outreach mentioned that federal agencies would not be able to do that kind of outreach or have the capacity to enact it alone (*Table 2.1*). Hiring a coordinator or liaison to work between partners or using a trusted partner to encourage communication and trust was touted as being crucial to the success of the individual projects.

Our findings indicate that adequate levels of capacity and expertise across partners led to a successful Joint Chiefs Partnership project in the few cases that it was present. Adequate capacity was rarely reported; instead, limited capacity and expertise and frequent staff turnover was reported almost universally as a barrier, especially within the NRCS (*Table 2.1*). Capacity and expertise limitations, seen in both agencies, were reported as delaying projects, limiting the degree of coordination possible and causing frustrations between the agencies. This challenge was compounded by the existing hiring freeze and perceived instability of the government structure at the time. One NRCS employee emphasized the limitations in their office, "This office had three people in it three years ago, and we had maybe a third of the active contracts that I do now. Now, I'm one person with two vacant positions in the office and three times the contract workload." Interviewees, including NRCS staff, reported many NRCS offices to be well-funded, but understaffed, overwhelmed or lacking necessary forestry expertise and capacity to accommodate the increase in funding. In some states, NRCS is primarily agriculturally focused, and in those cases, had little forestry experience or customer base; this was reported by both NRCS and Forest Service employees. If the local NRCS had little landowner connection before a project or were working with limited staffing, partners were used to increase that capacity or projects took longer to get rolling.

The receptivity of landowners, local stakeholders, and key individuals was reportedly essential to successful implementation of cross-boundary work. Landowners were reportedly more willing to work on their own land if work was also being done across the fence on Forest Service land or when state and local entities had some 'skin in the game', which drove participation for those landowners that did not historically participate in similar programs. Community leaders were reported as being able to break down a project in terms their neighbors

were receptive to in a way the agencies could not. One NRCS employee explained, "Nothing sells like watching your neighbor implement a practice and looking across the fence." Landowner outreach strategies were reportedly successful to differing degrees in terms of acquiring additional participants, bettering perceptions, and increasing education. About a quarter of interviewees reported a lack of landowner willingness to participate in a project, often because the landowner did not trust the federal government or could not afford to participate (*Table 2.1*). About a quarter of participants said that NRCS processes can be cumbersome, lengthy and expensive, often frustrating landowners and driving them away. Difficulty finding adjacent lands to work in was reported as a challenge by several projects, but did not often impact general project success. Participants stated they would have liked more adjacent work accomplished to create a contiguous treatment in those high priority areas. A Forest Supervisor explained, "Where it would have been most effective to do a treatment in an area next to a community, well, that landowner wasn't always willing, so we had to do the treatment somewhere else, but we still got it done. It just isn't as beneficial as, you know, doing it in the priority place." In some cases, working with so many and such a diverse set of landowners posed some logistical issues, and required an increase in coordination and time resources of internal and external partners.

As with any collaborative process, an understanding between and knowledge of the way each partner does business was necessary for effective coordination and cross-boundary work. A mismatch of Forest Service and NRCS processes was reported by a handful of the projects sampled (*Table 2.1*). In these cases, the agencies did not understand the other's processes in terms of jargon, expertise, funding streams, staff structure, or timelines. One Forest Service employee stated, "Even though we are both federal agencies under USDA, we're pretty different

in how we do business." Most projects, however, overcame this mismatch of processes as time went on and more coordination and learning occurred. NRCS privacy rules limited information sharing between partners on a few projects, making it difficult for other partners to effectively outreach to targeted landowners.

Having support and committed leadership at every level was reported as ideal, but our findings indicate that local or field-level support was the most important for success (*Table 2.1*). Projects had national support as direction and encouragement to use the authority came from the Washington Office of both the Forest Service and NRCS. Projects did not always have regional, state-level or local support. If a project's goals were not seen as a priority at all levels in the area, this posed challenges to work across boundaries. As one Forest Service employee explained, "You're overwhelmed as an individual worker, and you're not really inspired to go beyond that because you're just buried all the time. Unless you've got leadership that says 'Hey, I want this, make this a priority,' then you can start. Once you do it for a while, then you start seeing outcomes, but until the staff gets to see those outcomes, it's difficult to give them motivation when they're already working so hard." One project reported a lack of prioritization of project goals at the ground level and subsequent inappropriate use of program funding; while stream restoration was the goal, funding went toward agriculturally-focused NRCS efforts and the hiring of a state forester that placed little priority on stream restoration, the result of which was very minimal implementation of forest riparian buffers.

Policy-related delays were deemed minimally influential in overall project success by interviewees, suggesting the Joint Chiefs Partnership fit well into the existing legal structure. Cultural resource requirements and heritage surveys delayed projects up to one year. Not being NEPA-ready was only reported as a problem on a few projects, but being NEPA-ready was

discussed by the majority as very important to project success and faster timelines. In one case, the Forest Service was not NEPA-ready, which delayed their work for two years, causing some frustration and misunderstanding in the public eye. Policy-related delays were reported as a result of limited staff capacity and resources and less as a product of stringent legal structures (*Table 2.1*). As one Forest Service District Ranger explained, "It takes a lot of time, and it costs a lot of money, and so often times we are ready to go, wanting to implement these treatments, but we can't until the heritage surveys have been done, and we have very limited staff and very limited money to do that."

Table 2.1: Supplemental quotes in support of our findings

Increase in Pace and Scale
"I think it's allowed us to literally think outside the boundaries of the National Forest and look at better ways of accomplishing work than the way we seem to be locked into, in a lot of cases, inside our agency."
"We're under direction to increase the pace and scale of our restoration, and Joint Chiefs was a way to help us achieve that with the extra funding that came and being able to work with our state department of natural resources partners as well as the NRCS."
"We wanted to operate on a scale that was large enough to make a demonstrable difference throughout the landscape and to do that takes big funding… This enabled us to ramp it up, increase the pace and scale, and begin to connect some of the dots I guess, for lack of a better term. Again, those people that historically weren't interested in participating, once they saw the scope and the scale that we were operating in, they were willing to participate."
Requirement to Collaborate & Improved Relationships
"It really brought the NRCS and the forest together, sister agencies that to be quite honest, probably didn't have a whole lot of understanding about our potential overlap, in terms of our missions or at least the clientele that they work with and how they fit with the National Forest lands. So, bringing the NRCS into the equation brought a connection with the private forest landowners along their boundary that they had established through some of their other work."
"We are a part of USDA, but we rarely, in the past, have worked together, and this definitely made us work closely together and also involved the state's DNR. So, there was really successful collaboration in the story from that standpoint."
"In most cases people want to see their governments working together. When you have two [agencies] in the Department of Agriculture that are working together and then pulling in both NGO's and state government and university resources. It just builds credibility for everybody. And the fact is that you then are looked as a conservation leader, not just inside the green line, but certainly outside the green line."
More Work Across the Boundary
"Working with private land owners has given us access to a whole other element of the community, especially those lands that directly border the Federal ownership."

"I would say [Joint Chiefs] kind of gave the impetus to work a little bit more across that private land owner piece, right? The Forest Service, we do work with private land owners that are directly adjacent to our border, but this made us look a little bit further out, and look more holistically at the landscape."

"To me the biggest value added with this is working across borders … The forest doesn't stop at an arbitrary political boundary, and the work needs to be done across borders."

Added Partner Capacity

"Our capacity to get work done has just grown so immense through the partnerships that we have … we all have the same purpose and goals in mind, and we kind of have become a little bit interchangeable."

"The Nature Conservancy was doing a lot of the Science on looking for planning, looking at fuel and how that fuel load would affect the regeneration or damage of those urban areas … They had some staff that have PhD's in Fire Ecology so they were doing a lot of the Science for us."

"In our partnership group, we've really played to our strengths. Like we're all invested in all parts of the program but in different ways. Great communication is important, working to understand each other's roles so that we can fill that need. I think that, that's really made it more efficient because we can all lean on each other to meet different needs."

Enduring Collaborative Capacity

"You know, it definitely strengthened the relationship with NRCS, and since the project was initiated and some of the work has been implemented, I know we've continued with coordination meetings with NRCS that we didn't do in the past, even beyond sort of what the original focus of the project was. There's been a renewed emphasis on that coordination and collaboration with NRCS.

"I think the biggest thing is we've really begun to look at a larger scale of project work. In the past, NRCS has really just focused on private lands …We've kind of been doing our own thing, but now we cooperatively work with the Forest Service and have certainly a better understanding of what they do and what we do, and I think the strength is certainly in building partnerships with all the federal and local agencies."

"In today's world, we're going to have to keep those relationships active and continue to collaborate with them. Because, I think project proposals look a lot better and have a higher chance of working when you have partners on board. When you do it the kind of going-it-alone approach, that doesn't necessarily work. It's strength in numbers."

Multi-year, Committed Funding

"We're making a difference faster and in a more timely way, and sometimes a more holistic way, then we would have if we'd had to nickel and dime this out of the existing appropriation. Because we were incentivized in a larger way to get something done and that's great juice to have."

"In order to incentivize good habitat improvement, good forest management, we need to fund these projects so these private landowners will have access to practices to achieve all our goals."

"The Joint Chiefs funding really gave a bigger boost. Instead of a couple hundred thousand, we could request a couple of million dollars where we could really accomplish those goals … Generally, the work is not accessible or affordable to the average homeowner on any kind of larger acreage. They might complete the defensible space treatments around their home and structures but the work just doesn't get accomplished without the programs or the partnership in place. It really solidified the partnerships, really solidified our program so that we could roll out something that had more continuity."

Established Relationships

"We have a good collaborative group in place, and we have a purpose. We just fold all these projects into it."

"[Partner and landowner engagement] was there before Joint Chiefs, it will be there after Joint Chiefs. We continue to do lots of things with our partners."

"We're able to plug into a framework that includes years of successful planning, implement it and the social capital of our partners, and then we find creative ways to support each other and take advantage of what each organization can offer."

Linkage Institutions

"Without their on-the-ground capacity and their local cachet with the community (they're well known, respected, trusted) people oftentimes who don't trust government have a high degree of trust in the [restoration crew] and The Nature Conservancy as our other key partner."

"Well I think from the standpoint of the collaborative group, the capacity that they added to the process was they helped work out the differences of opinion and find common ground amongst a variety of audiences in regards to what we were trying to do and what we had proposed in this process."

"We sent letters from the fire department… And I think that people are really receptive to that because they're the good guys."

Capacity and Expertise

"Right now, I have a twenty percent vacancy in the hiring freeze. So, I have to make decisions daily on where we're going to put our time."

"NRCS was facing limited capacity to plan on forest land and kind of start from scratch in the outreach and customer development phase. That was a huge barrier to overcome."

"In this state in general, we've gone from a high of 480 employees to today, we're right around 204. So, yeah, we get spread a little thinner, do more with less; that creates challenges. Obviously, you can't spend as much time on certain things as you'd like. You kind of have to pick those top priority things and really hone in on those and see that they get done as well as you can and as timely as you can."

Landowner Participation & Adjacent Lands

"There were some landowners that are skeptical dealing with the federal government. We kind of had that, and that's like that with many of our programs. There's a lack of trust with some of the federal government."

"You know, I think it's more of a matter of quality of work that we weren't able to accomplish, which is okay. In terms of most important acres, I'm not sure we were always able to get that planned and implemented across the land ownership."

"We really had to kind of identify which landowners were interested in participating, because even though we may have found a high priority area, if you have a landowner that's resistant to doing anything, we really can't spend a lot of time there knowing that we don't have an interest."

Agency Process Match

"One of the awkward things as we worked through this was we're each a staff agency, for lack of a better term… I'm a base leader, who's my counterpart within the Forest Service?"

"[NRCS has] pretty limited staffing, and I think that piece was challenging for them to do the landowner contacts. Frankly, we offered to give them a hand with all that, and they thought they could handle it just fine."

"The way the Forest Service was able to mobilize and accomplish projects and the way NRCS was able to mobilize and accomplish projects, is distinctly different. The idea that, I think, the Chiefs had when they said, "Let's do this.", I don't think that they knew how different the two agency's methods of work were."

Leadership and Local Support

"There's been engagement … at the local, state, and federal level, and that's been really important to the success of this project."
"I think at the state level, there was some hiccups because that person was probably too busy taking care of other issues, once we transitioned to working with local people with our projects, it was a huge success."
"You have to have a leadership structure in place that allows you to be somewhat creative and innovative as you put projects together. We had that in the state. We had that trust and that willingness to take an informed risk."
Fit in Existing Legal Structure
"Well, I don't know if [NEPA] slowed things down because it's a requirement, it's the law. So, we're just used to doing it."
"You know, some of the culture resource assessments slow things down a bit, but we were able to work through those eventually…That was one where State Forestry helped us out."
"Well, from the NRCS standpoint, our implementation rate has been poor, because of our Cultural Resources Policy in the state. Some of the contracts that were written in 2015 and 16, landowners haven't even been able to begin to work on those to implement them, because they've been delayed because they haven't received Cultural Resource clearance."

5. DISCUSSION

We return here to our research questions, reflecting on what our findings indicated about the benefits of the Joint Chiefs Partnership approach and the underlying factors that facilitated or hindered success. We then reflect on what can be said about policy design to facilitate cross-boundary work more broadly.

5.1 The Joint Chiefs Partnership: Lessons on Policy Design and Implementation

A majority of respondents said about the Joint Chiefs Partnership that the infusion of funding and cross-boundary, collaborative requirement supported larger scale and cross-boundary work. The Joint Chiefs Partnership made more formal space for collaboration with non-state actors, which is important for accomplishing work across jurisdictions and with multiple actors, and combined the capacity and expertise of two USDA agencies to work across boundaries on forested landscapes through collective action (Innes and Booher 2003). External partners were used to stretch the capacity of their federal partners and provided funds to invest in priority landscapes and accomplish more work on funded landscapes. The multi-year funding

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commitment and credibility of seeing others come to the table led to greater collective action and leveraging of funding. The design of Joint Chiefs Partnership provided considerable flexibility in use of funding, identifying restoration activities and goals, the location and scale of management, and relevant external partners. Trust between the two agencies and with their partners resulted in the use of the creativity and flexibility the Joint Chiefs Partnership allows, both of which are necessary components of effective cross-boundary policy design (Decaro et al. 2017).

Some of our interviews indicated that working collaboratively toward a landscape-scale approach caused a shift in the way partners on a few projects conceptualized or implemented subsequent management actions. For example, seeing successes with a Joint Chiefs Partnership project encouraged greater collaboration, conceptualizing management at the landscape scale, and being part of similar projects in the future. This type of learning and diffusion of practice is important for continued success, according to the adaptive governance literature (Cash et al. 2003, Innes and Booher 2003, Cumming et al. 2012). Successful Joint Chiefs Partnership projects created momentum for continuing similar restoration efforts across the boundary with the established partnerships and plans.

The implementation of the Joint Chiefs Partnership was met with differential success depending on a variety of local conditions. The most critical factor underlying effective cross-boundary work and project success was having established collaborative relationships. Those projects working within established relationships often had greater degrees of credibility within a community and had systems in place to handle dissention or differences in opinion. Similarly, it was necessary for the Forest Service and NRCS to understand each other's processes and be able to work together for cross-boundary work to be accomplished. As expected based on the literature, it was also important to use collaborative, external partners, or landowners as linkage

institutions that could provide trustworthy outreach and education to the public and landowners (Cash et al. 2003, Kettl 2006, Decaro et al. 2017, Abrams et al. 2017a). While high or adequate levels of capacity were rarely reported, those projects that did have this were generally able to get more planning and implementation done across boundaries. If there were receptive landowners that were willing to participate in the implementation process, projects were able to conduct work on prioritized acres at the boundary. Our findings indicate that local or field-level support was necessary for success.

Those projects with partners that reportedly did not work well together often struggled with the new, cross-boundary approach; working across physical and institutional boundaries is a focal challenge in the public administration literature (Kettl 2006). Limited capacity and frequent staff turnover was reported almost universally as a barrier to cross-boundary work, causing project delays, limiting the degree of coordination possible, and causing frustrations between the agencies. Similarly, a mismatch of Forest Service and NRCS processes was reported as delaying projects and causing frustration between the agencies. When an area's landowners were unwilling to participate in a project it often limited the amount of adjacent and prioritized lands that could be managed under the Joint Chiefs Partnership. If a project's goals were not seen as a priority at all levels in the area, this posed challenges to work across boundaries.

5.2 Implications for Designing Policy to Support Cross-Boundary Work

This study demonstrates how many of the recommended features of policy design to support more adaptive, cross-boundary work can manifest in a specific legal and institutional context. Our research affirmed a successful policy must include or allow for the involvement of non-state actors as capacity builders and as part of linkage institutions (Folke et al. 2005, McCarthy 2005, Schultz et al. 2012, Decaro et al. 2017, Maier and Abrams 2018). Our findings

suggest requirements to collaborate build upon existing relationships and help to support the creation of new ones that yielded benefits. This requirement improved management and planning efficiencies in the sense that partners could achieve more than any single entity could, something that the literature has highlighted as important (Craig et al. 2017, Cumming et al. 2012). Partners were used to stretch the capacity of their federal partners in terms of staff, expertise, additional funds, leveraging their programs, science, and community relations. Partners also acted as linkage institutions, providing trusted outreach and communication to landowners and other stakeholders; others have noted that such institutions are critical for addressing environmental governance challenges at larger scales (Cash et al. 2003, Decaro et al. 2017, Abrams et al. 2017a). Most interviewees valued this collaboration requirement and will continue those partner relationships as they are perceived as necessary to get work done or make their project proposals more competitive in the future.

Our research also supports and contributes to the policy design literature by highlighting the importance of committed long-term funding as a necessary component to a successful collaborative effort. Our data indicate that offering multi-year funding, which is allocated to places with collaborative efforts in place, is a successful policy strategy for cross-boundary work; this will be critical going forward to managing for fire hazard, as it is unlikely that private landowners will be able to address treatment priorities without allocation of public funding (Theobald and Romme 2007). However, the duration of those funding commitments may need to vary program to program, or even project to project. Flexible, multi-year funding commitments made available through the Joint Chiefs Partnership incentivized participation across the boundary by both partners and landowners and supported long-term programs of work, but we suggest three years may not be enough. While an increase in NRCS staff capacity was reported

as necessary, hiring on of permanent staff is often not sustainable with a three-year funding cycle. If capacity building is a necessary component to the success of a policy, longer investments may be necessary. Many of the projects focusing on fuels reduction have the next step of reintroducing fire in areas that they mechanically treated during the Joint Chiefs Partnership funding period, which will require additional years of funding. Longer-term committed funding could open space for industry and market development, reintroduction of fire, hiring of additional staff capacity, and increased training. We recognize that longer-term flexible funding may be more challenging to account for and requires additional internal tracking mechanisms to ensure oversight.

As a practical matter, prioritization of funding awards will need to occur where partners have agreement and are able to leverage external capacity and dollars to effect change at meaningful scales. Our research affirmed a successful policy must have tangible support at the national, state, and local levels, but we suggest local support and capacity to be the most crucial to success (Decaro et al. 2017). Land management and cross-boundary efforts are affected by local context; policies like this can either support existing momentum or help to build it. Our findings suggest projects were generally more successful when that support was prioritized in an area already experiencing momentum. If agencies wanted to select for such projects, they could do so in proposal processes, selecting for collaborative history presence and connections with willing partners, and potential for added capacity and leverage funds. Our findings also suggested that the hiring on of a program liaison or coordinator and use of a trusted outreach institution were key factors of success.

As agencies move toward prioritization, they will need to be vigilant about examining tradeoffs. While the prioritization and funding of projects contributes to the effectiveness of

cross-boundary implementation, it may also be seen as harming important work elsewhere. In our work, we heard reports of some instances of resentment from other sectors of the Forest Service, either on the same national forests, where programs or other landscapes may have been diminished to support Joint Chiefs efforts, or from other national forests that had not received funding under the Partnership. The consequences of prioritizing some activities and locations over others should be a consideration for policy designers regarding the system-wide impacts of such decisions.

Finally, the rest of agency process and capacity must line up to make the most of these programs. Our findings indicate that more needs to be done to reorient agency capacity and address expertise gaps, as a successful collaborative approach is difficult when working within agency cultures and capacities (Kettle 2006, Decaro et al. 2017). Turnover of key staff is a substantial obstacle, leading to delays in project implementation and frayed relationships. If the agency is going to set aside funding for the prioritization of landscapes, it must also provide funding to build adequate capacity in the long term. We also suggest attention be paid to training and identifying effective leadership that will consistently support the collaborative process. The design of the Joint Chiefs Partnership created space for collective action and overcoming scale challenges, but limitations associated with persistent agency institutions consistently inhibited project implementation. Others similarly have noted that adaptive governance can proceed only at the pace of its slowest moving institutions (Abrams et al. 2017b).

6. CONCLUSION

As fire suppression consumes an ever-greater proportion of the Forest Service budget, the agency is looking for new ways to leverage partnerships and external funds and prioritize

investments to work at large scales. To improve environmental governance, scholars across

disciplines emphasize the need for collective action and collaboration to find agreement,

prioritize, increase capacity, and work across ownerships and boundaries (Folke et al. 2007, Cash

et al. 2006, Kettl 2006, Cumming et al. 2012). Our research investigated this governance

approach by examining the effectiveness of the Joint Chiefs Partnership policy in tackling the

challenge of large-scale, collaborative, cross-boundary work, using the policy design literature to

understand which aspects of the design of the authority supported that goal. We also investigated

the factors and underlying conditions that helped projects be successful and what factors got in

their way.

Our research contributed to the policy design literature, suggesting the need for

committed, multi-year funding as essential for a successful collaborative, cross-boundary

authority. Flexible, multi-year funding can incentivize participation across the boundary and

bring more actors to the table. Multi-year funding enables projects to leverage partner dollars,

work at larger scales, and maintain projects as a priority. Committed funding past the three-year

mark could open space for industry and market development, reintroduction of fire, hiring of

additional staff capacity, and increased training. We also suggest the prioritization of funding

commitments will be most effective and need to occur in areas already experiencing momentum,

where partners have agreement and are able to leverage external capacity to effect change at

meaningful scales. The most effective duration of such funding commitments may require

variance and flexibility, depending on program goals and local context.

Our findings were consistent with the policy design literature in that a successful policy

must include or allow for collective action and the involvement of multiple non-state actors as

capacity builders and linkage institutions. Our findings also affirmed the need for planning and

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implementation across ownerships and jurisdictions. Through study of environmental governance literature and our findings, it is clear that agency processes and institutions must catch up with emerging governance approaches that encourage collective action and work across ownerships for those approaches to be successful.

A sample-related limitation of this research study is its look at just two of the five years in which projects were awarded funding. Those projects awarded in Fiscal Years 2016, 2017, and 2018 will need to be evaluated to further understand the long-term utility of the Joint Chiefs Partnership. An additional limitation is the lack of survey data, which would have provided more generalizable findings and the opportunity for statistical analysis. As with most qualitative research, our study would be difficult to replicate (Yin 2015). We did not evaluate the effects on the ground of implementing a Joint Chiefs Partnership project. Instead, we relied on participant perspective of success or lack of success in terms of improved wildlife, watershed, and fire conditions. As we did not assess the efficacy of this policy on the ground, it is difficult to fully understand or speak to the success of its designs beyond participant perspectives.

The critical need for land management to span boundaries and large scales means more federal tools will be designed to accomplish such work. To broaden understanding of successful policy design to effect change at large-scales, it will be important for future studies to understand the effects of prioritization and scale decisions and how they can impact social governance and agency processes. It is important to understand how these tools and authorities can be better designed to support work across agencies and jurisdictions. As the Joint Chiefs Partnership was refunded for 2019, this study can provide a baseline for future research evaluating the long-term success of this program and comparing it to land governance initiatives with similar goals, in order to identify which elements of policy design best support successful large-scale,

collaborative, cross-boundary work. A future research project could investigate learning as it pertains to such tools, and whether it is individual or collective, instrumental or conceptual, and temporary or enduring learning. Another opportunity for meaningful research would be to determine the most effective duration of committed funding, as it pertains to collaborative, cross-boundary efforts.

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Hayman Fire Data Sources

Cost Type	2018 Study	Source
Accrued Costs Since 2004		
Recovery/Rehabilitation $	4,871,410.00	USFS ; CSFS;
Watershed Damages and Dredging Costs $	28,100,000.00	Denver Water; Aurora Water
Coalition for the Upper South Platte $	16,300,000.00	Coalition for the Upper South Platte
Business Losses $	4,333,600.00	Lost Valley Guest Ranch; Rocky Mountain Recreation Company; Canyon Enterprises; Angler's Covey; Local YMCA; Camp Shady Brook; Ramah Camp
Flood Damages $	8,819,878.00	Douglas County; Park County; Teller County; CDOT
Accrued Cost Total Since 2004 $	**62,424,888.00**	

West Fork Complex Fire Data Sources

Cost Type	Total Estimated Cost	Source
Direct Costs		
Suppression $	33,200,000.00	Daily Camera
Evacuation Costs $	125,942.00	Rio Grande County
Timber Loss $	19,083,102.00	USFS GIS Data and Analysis
FEMA Support $	7,939,303.00	FEMA
Rehabilitation Costs		
Road Reconstruction $	394,358.00	CDOT; BAER Report; Rio Grande Watershed Emergency Action Coordination Team (RWEACT)
Planting/Restoration $	420,481.00	RWEACT
Watershed Recovery $	364,500.00	Black Creek Hydrology; BAER Report; Private Landowner
Trail Closures $	58,814.00	BAER Report; RWEACT
BAER Funding $	574,049.00	USFS
Monitoring $	3,600.00	BAER Report
Indirect Costs		
Business Losses $	650,000.00	4UR Ranch; Rio Grande Vacation Rentals; Owner of Hydroelectric Unit
Flood Damage $	3,000.00	USFS; Black Creek Hydrology
Grazing Allotment Damages $	66,084.00	BAER Report; USFS Rangeland Specialists on Rio Grande and San Juan National Forests
Marketing for Economic Recovery $	355,000.00	RWEACT
Forest Plan and Community Plan Updates $	193,750.00	RWEACT
Improved Emergency Notification Efforts $	2,500,000.00	RWEACT
True Cost of the West Fork Complex Fire $	**65,931,983.00**	

Black Forest Fire Data Sources

Cost Type	Total Estimated Cost	Source
Direct Costs		
Suppression $	9,230,000.00	Wildfire Today
Insured Property Loss $	420,500,000.00	Wildfire Today; El Paso County Assessors Office; The Rocky Mountain Insurance Information Association
Uninsured Property Loss $	38,686,000.00	Evan Walker Law (46% of homeowners were underinsured by 20% in the fire footprint)
Value of Trees Lost $	29,920,862.00	El Paso County Assessors Office
FEMA Support $	6,617,742.00	FEMA
Rehabilitation Costs		
Thinning of Burned Timber $	1,137,500.00	Tree Beavers; Hope Restored; Pineries Ranch; Black Forest Together
Planting/Restoration/Trail Reconstruction $	1,875,883.00	El Paso County; Rocky Mountain Field Institute
Black Forest Together (volunteer time, expenses, rehabilitation, grants) $	1,702,890.00	Black Forest Together
Coalition for the Upper South Platte $	10,000.00	Coalition for the Upper South Platte
Indirect Costs		
Mental Health Grants $	282,615.00	Aspen Pointe
Tax Losses to El Paso County $	43,430.00	El Paso County Assessors Office
Flood Mitigation/Recovery Costs to County $	15,736,562.00	El Paso County Roads Department; El Paso County Parks Department
Updates to Community Wildfire Protection Plan $	80,000.00	Dahl Services
True Cost of the Black Forest Fire	**$ 525,823,484.00**	

Introduction

1. Can you tell me about your current role and how you engage with Joint Chiefs?
2. What were your primary project goals?
3. What was the reason/goal for participating in the Joint Chiefs? What were you hoping to accomplish through Joint Chiefs that you did not feel you could achieve under the traditional governance structure?
4. In your mind, what has been the value added of the JC program? If someone were to ask you if JC was successful or if it should be refunded, what would you tell them and what could you show them?

Facilitators of Success

1. What do you feel are the greatest facilitators of any progress your collaborative has made? What's working and why? How have those factors helped your project succeed?
   a. Agency variables (local leadership, increased capacity and funding, etc.)
   b. Working with collaborative
2. What degree of support has your project had from local, regional and federal partners?
3. How has the program affected partnership and community relationships?
4. What prior investments or strategies did you have that helped you compete for funding and implement your project?
5. How do you feel your project and goals fit within the broader Forest Service or NRCS culture? In other words, does the JC fit in pretty easily or is it a new way of doing business?
6. How does leadership on your project communicate and how often? How were you able to engage the collaborative you were working with?
   a. Dig into: communication with JC people, regional?
7. What has been your communication strategy more broadly? Have you worked with groups outside of your collaborative to advocate for your project?

Inhibitors of Success

1. What types of challenges have you and your partners faced? In what ways have these barriers impeded your ability to achieve goals?
   a. Agency variables
   b. Infrastructure and markets
   c. You have money and others don't – any resentment?
2. What have been some ways or strategies you all have utilized to overcome the barriers you mentioned previously? Do you have any ideas of how you could overcome these challenges in the future (lobbying, networking across scales and venues, field trips, etc.)?
3. Are there any acts, procedures, regulations or legal structures you think make it challenging to accomplish your goals?
4. How has the ecology of the area under your project impacted your ability to reach your goals? In other words, is this a complex system to work in? Are you dealing with lots of changing conditions?
5. Have you worked with groups or partnerships outside of your project to advocate for your project in terms of money, time, communication, knowledge, staffing, etc.?
   a. Do you have the science you need? Did you work to bring in partners with scientific capacity for your project? Did your project ever experience information or data gaps that acted as barriers?
6. Have you moved the needle on fire management in any way? WO wants to know about fire management. What are your approaches to proactive and reactive management of fire? Were you successful in your goals?
7. Were you ultimately able to accomplish your project goals?

Conclusions

1. What does the future look like for sustaining your effort? Your partnerships? Will you be able to sustain the level of engagement with partners?
2. When the JC dollars run out what are you going to do?
3. Is there anything you'd recommend changing about the JC program as a whole?
   a. Funding structure
   b. Proposal process

        c. Communication

4. Is there anything else you want to talk about or anything you feel I should have asked about?

5. Who else should I talk to, to hear a broad range of perspectives about your project?

APPENDIX C: DETAIL ON CODING METHODOLOGY

Coding and memoing methods were derived from the grounded theory method developed by Corbin and Strauss (2014). All interviews were recorded, transcribed, and analyzed through coding in Dedoose, an online platform for qualitative researchers. We used codes to organize our data and identify emergent themes including successes, program value, challenges and barriers, future recommendations, and innovations. Initial codes were closely linked to these broad themes. We reviewed transcripts and examined excerpts for individual codes, writing a memo for each code, which provided an additional analytical step for looking at all comments on a topic together at once. The same codes were used to analyze interviews with agency staff as well as external partners, and multiple codes often applied to single quotations. The following table includes the codes used during analysis of this research and an explanation of each code's intent.

Codes	Explanation of Use in Transcripts
Barriers - *External* - *Internal* - *Policy Related*	Reported challenges or factors that inhibited success of a project either temporarily or permanently. Sub-codes were used to differentiate challenges seen internal to the agency, external to the agency, and those that were policy related.
Collaboration	Evidence of collaboration among agency staff or with external stakeholders.
Facilitating Factors - *External* - *Internal*	Reported facilitating factors that helped the project come together or be successful in some way. Sub-codes were used to differentiate those facilitating factors that were seen within the agencies or external to the agencies.
Fire Management	Any mention of fire management or activity.
Next Steps	Expressions of future plans relating to a Joint Chiefs Partnership project, the partners working on it, or another project/activity that was inspired by a Joint Chiefs Partnership project.
Program Recommendations	Suggestions for alternations to the design or implementation of the Joint Chiefs Partnership with the intention of improving the authority.
Project and Program Success	Reported value of the authority or expressions of overall success.