DISSERTATION

CULTIVATING COLLABORATIVE ADAPTABILITY IN PUBLIC LANDS SOCIAL-ECOLOGICAL SETTINGS: LINKING THEORY, PRACTICE, AND EVALUATION ACROSS CASES AND CONTEXTS

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ABSTRACT

CULTIVATING COLLABORATIVE ADAPTABILITY IN PUBLIC LANDS SOCIAL-ECOLOGICAL SETTINGS: LINKING THEORY, PRACTICE, AND EVALUATION ACROSS CASES AND CONTEXTS

Collaborative and adaptive forms of governance have become increasingly common in environmental management as they are claimed to help reduce conflict over resource management issues and uncertainty, increase trust, support shared understanding and buy-in for management actions, and facilitate social learning. In the USDA Forest Service, legal, regulatory, and bureaucratic challenges, and the increased emphasis on ecosystem management has increased the demand for, and investment in, collaboration as a tool to meet forest and fire management goals. Collaborative governance and adaptability scholarship has documented the key drivers and external conditions that influence collaboration, the internal dynamics that cultivate or constrain collaboration, and the outputs and outcomes of collaboration. Still, a number of research gaps remain that, if addressed, could advance the theory and practice of collaborative governance. First, the ways in which groups adapt and remain resilient to inevitable internal and external changes remains underexplored. Second, despite over twenty years of research in this space, relatively little is known about the configuration of, and relationship between, factors that comprise collaborative governance and adaptability. Third, collaboration is dynamic. As groups evolve, they create value in different ways, and their needs and priorities change. Thus, there is a need for periodic and ongoing assessments of how collaboration is working in local contexts, current challenges, and what adaptations are needed to improve collaborative processes and progress. This dissertation starts to address these research gaps and needs.

I situated this work within the Collaborative Forest Landscape Restoration Program, a Forest Service-administered program first authorized in 2009 and reauthorized in 2019. The work presented in this dissertation was co-developed with the Southwest Ecological Restoration Institutes and the Forest Service Forest, Range Management, and Vegetation Ecology Program. Specifically, the work supported synthesis of lessons learned from the first 10 years of the CFLRP and the development of a standardized and longitudinal assessment of collaborative governance and adaptability for use in the CFLRP Common Monitoring Strategy.

Broadly, my dissertation contributes to our understanding of the factors that facilitate or frustrate adaptation to inevitable change in collaborative settings. This is a critical line of inquiry given the increased and sustained investment in long-term collaborative environmental management in the United States and beyond. I employed a mixed-method analysis consisting of focus groups, program-wide surveys, and a systematic review, and I drew on the Integrative Framework for Collaborative Governance, collaborative adaptability and resilience literature, and organization theory to frame my analysis.

In Chapter 2, I asked, how do collaborative governance regimes adapt to disruptions and what barriers constrained collaborative resilience? I found that collaboratives demonstrated the ability to mobilize social capital, learning, resources, and flexibility to respond to disruptions. Yet authority, accountability, and capacity complicated collaborative resilience. I conclude Chapter 2 with policy and practice recommendations to cultivate collaborative resilience moving forward. In Chapter 3, I developed and deployed a program-wide collaborative governance and adaptability assessment to all currently authorized CFLRP projects. I used a modified grounded theory approach to document and describe CFLRP project respondents' recommended actions and adaptations to improve collaborative processes and progress towards desired outcomes. Key recommendations included the need for: inclusive engagement throughout the process; institutional arrangements; resources and capacity; monitoring

and social learning; trust, relationships, and commitment; external communication and outreach; and local autonomy in decision making. I discussed these findings in light of collaborative governance theory and practice and included relevant resources and actions that practitioners and funders of collaboratives and policy actors may consider to support collaboratives in working towards forest and fire management objectives. In chapter 4, I again used the program-wide CFLRP collaborative governance and adaptability assessment, and I used confirmatory factor analysis to test assumptions underlying the dimensional structure, reliability, and validity of measures thought to comprise collaborative governance and adaptability. I found that the components of collaborative governance and adaptability comprised six dimensions – principled engagement, shared motivation, leadership, resources, knowledge and learning, and institutional arrangements. As expected, several dimensions were significantly related, and the pattern of inter-factor relationships aligned with theoretical and empirical assumptions. We also found that the six dimensions represent statistically reliable, valid, and distinct measures that may be used to evaluate collaborative governance and adaptability. While our focus was on the CFLRP, the assessment can be adapted to other collaborative environmental governance contexts. Chapter 5 ends with a summary of findings, limitations of the work, and future research directions to address lingering questions about collaborative environmental governance.

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TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

In recent decades, collaborative and adaptive forms of environmental governance have emerged across the globe in response to growing conflict over resource management and increasingly complex, uncertain, and wicked environmental challenges (Margerum and Robinson, 2016; Wondolleck and Yaffee, 2000). There was growing recognition that these environmental challenges could not be addressed by working alone and a diversity of knowledge, perspectives, and capacity was needed to address them. Collaborative approaches are claimed to help minimize conflict and uncertainty, enhance efficiencies, increase trust- and relationship-building and legitimacy of efforts, support shared understanding and support for management actions, and increase knowledge sharing and social learning (Agranoff, 2006; Emerson et al., 2012; Folke et al., 2005; Gupta et al., 2010; Pahl-Wostl, 2009; Wondolleck and Yaffee, 2000).

The interest in, and demand for, collaboration in the USDA Forest Service started to take shape in the early 1990's in direct response to declines in organizational legitimacy, autonomy, discretion, and capacity, and the increased emphasis on integrated ecosystem management (Abrams, 2019; Cortner et al., 1998; Margerum and Robinson, 2016; Wondolleck and Yaffee, 2000). The Forest Service continues to invest in collaboration as a tool to meet national forest and fire management policy goals through the Healthy Forest Restoration Act of 2003, the Natural Resource Conservation Service and Forest Service Joint Chiefs' Landscape Restoration Partnership, Shared Stewardship, and the Collaborative Forest Landscape Restoration Program (CFLRP) (Cyphers and Schultz, 2019; Kooistra et al., 2022b, 2022a; Schultz et al., 2012).

Scholarship on collaborative governance and adaptability is informed by multiple disciplines, including public administration, conflict management, planning, adult education and learning, systems thinking, and environmental governance (Ansell and Gash, 2007; Armitage et al., 2010; Daniels and

Walker, 2001; Emerson et al., 2012; O'Leary et al., 2006). Collaborative governance is defined by Emerson et al. (2012) as "the processes and structures of public policy decision making and management that engage people across the boundaries of public agencies, levels of government, and/or the public, private for-profit, and civic spheres to carry out a public purpose that could not otherwise be accomplished" (Emerson et al., 2012, p. 2). Collaborative adaptability, or adaptive capacity, refers to "the ability of the CGR [collaborative governance regime] to alter its internal processes or convert structural elements as a response to experienced or expected changes in the societal or natural environments" (Emerson and Gerlak, 2014, p. 770).

Scholars have contributed to the theory and practice of collaborative governance and adaptability by documenting and understanding the key drivers and external conditions that influence collaboration (Ansell and Gash, 2007; Cheng and Sturtevant, 2012; Daniels and Walker, 2001; Emerson et al., 2012), collaborative structures and processes that facilitate or frustrate collaborative governance and adaptation (Ansell and Gash, 2007; Bingham and O'Leary, 2006; Emerson et al., 2012; Emerson and Nabatchi, 2015a; Feldman et al., 2006; Margerum and Robinson, 2016; Thomson and Perry, 2006), and the outputs and outcomes of collaborative governance (Ansell and Gash, 2007; Bryson et al., 2006; Emerson and Nabatchi, 2015b; Koontz et al., 2020; Koontz and Thomas, 2006). There now exists multiple frameworks, case studies, and surveys that outline key benefits, outcomes, and challenges of collaboration.

Still, a number of knowledge gaps remain, that if addressed, could help advance the theory and practice of collaboration. First, the ways in which collaboratives adapt and remain resilient to change is under-explored (Butler and Schultz, 2019; Cheng et al., 2015). Second, collaboration is a dynamic and evolving process. Collaboratives create value differently through time, and thus the actions and adaptations collaboratives need to enhance their process and continue making progress is context- and time-dependent (Imperial et al., 2016). Third, most research in this arena has conducted individual or

small-n case studies, which has resulted in variable metrics and factors[1] used to measure collaborative governance and adaptability. In turn, this limits cross-case and cross-context inference (Koontz et al., 2015; Siders, 2019). Relatedly, we lack consensus on the number and configuration of, and relationship between, factors that comprise collaborative governance and adaptability, and most studies have not formally tested the dimensional structure, reliability, and validity of those factors. Thus, there is a clear need for: 1) exploring how collaboratives adapt and remain resilient to change; 2) periodic and longitudinal assessments of what is working well in local collaborative contexts, current challenges, and what collaborative groups need to improve the collaborative process and continue making progress as they evolve; and 3) systematic and cross-case assessments situated within robust statistical frameworks to test the configuration and validity of collaborative governance and adaptability measures. This dissertation starts to address the above knowledge gaps and research needs.

I situated this work within the CFLRP, a Forest Service-administered program aimed at facilitating science-based collaborative forest restoration in high-priority landscapes across the United States. The CFLRP was originally authorized by the Forest Landscape Restoration Act (FLRA) of 2009 and was reauthorized by the Agricultural Improvement Act of 2018. The CFLRP was a unique policy instrument in the U.S. in that the Forest Service committed funding to projects for 10 years and collaboration was mandated throughout planning, implementation, and monitoring. However, collaboration was not defined in the FLRA or CFLRP, nor were guidelines set for how collaborative protocols and processes should be structured. Local projects were given the flexibility to develop and adapt their collaborative structures and functions to their local socio-cultural, historical, and ecological contexts (Schultz et al., 2012). The CFLRP, thus, offers a unique natural experimental setting to study collaboration across time and diverse contexts but under the same policy instrument.

[1] Factors in this sense refers to latent (unobserved) variables or constructs. Factors typically include a number of statements in a survey thought to measure the same concept, for example collaborative adaptability.

Broadly, this dissertation contributes to our understanding of the factors that facilitate or frustrate adaptation to inevitable change in collaborative settings. This is a critical line of inquiry given the increased investment in long-term collaboration to meet national policy goals associated with forest and fire management. Specifically, my objectives were to:

- Document how groups adapted to disruptions and the barriers that constrained adaptation (Chapter 2);
- Identify actions and adaptations needed to improve collaborative processes, progress, and performance as collaborative groups evolve (Chapter 3); and
- Develop reliable and valid measures of collaborative governance and adaptability for cross-project and longitudinal assessment of collaborative resilience under change (Chapter 4).

To address these objectives, I employed a mixed-method analysis consisting of focus groups, program-wide surveys, and a systematic review. I also draw on several lines of theory and practice. First, the Integrative Framework for Collaborative Governance (Emerson et al., 2012) is a useful framework within which to situate my work because it: 1) synthesizes the theory and practice of collaborative governance from many fields (e.g., conflict management, public administration, environmental governance, planning); 2) builds upon prior synthetic and fundamental work on collaborative governance (Ansell and Gash, 2007; O'Leary et al., 2006, and the special issue therein); 3) incorporates multiple components of collaborative governance into a nested, multi-level framework which allows for the study of collaborative governance as a whole or among its constituent parts; and 4) proposes causal linkages among system components, which allows for testing relationships and interactions among components. The framework posits that collaboration is nested within, and both influences, and is influenced by, internal and external social-ecological factors. External social, political, economic, and environmental contexts and drivers can facilitate or frustrate collaboration. Internal collaborative dynamics include principled engagement (e.g., having the right people, developing shared agreement on problems and

actions to solve problems), shared motivation (e.g., trust and relationship building), and the requisite capacities for joint action (e.g., resources, leadership, institutional arrangements). As groups work together, they jointly produce actions that result in adaptations among the collaborative or external environment, and outcomes on the ground.

Second, I include concepts from collaborative adaptability and resilience thinking (Folke et al., 2010), which acknowledges change as a fundamental property of the system. Resilience is defined here as a collaborative's ability to buffer disturbance and adapt to social and environmental change without losing desired structure, function, feedbacks, and identify (Walker et al., 2004). Resilience thinking is concerned with managing complexity and uncertainty in social-ecological systems by anticipating, responding to, and shaping change (Berkes et al., 2003; Chapin III et al., 2009; Emerson and Gerlak, 2014). Governance regimes that enables flexibility, provide opportunities for social learning and building social capital, help leverage resources, and connect networks across scales is thought to help manage uncertainty, complexity, and change in environmental management (Chaffin et al., 2014; Dietz et al., 2003; Folke et al., 2005; Gupta et al., 2010). Yet, a host of institutional, structural, and socio-interactional barriers can constrain the latitude for adaptation (Abrams et al., 2017; Cheng et al., 2015; Moote and Becker, 2003; Nelson et al., 2007; Schultz et al., 2021; Wondolleck and Yaffee, 2000).

Third, I pull from organizational change theory to characterize how groups evolve. The useful life of network governance, for example, posits that collaborative governance regimes go through non-linear stages throughout their lifecycle (Imperial, 2022; Imperial et al., 2016; Ulibarri et al., 2020). As collaboratives evolve, they provide value in different ways and are likely to produce different outputs and outcomes. Further, the resources and support they need to continue making progress is context- and time-dependent (Imperial et al., 2016; Ulibarri et al., 2020). Organizational theory tells us collaboratives must navigate variable, conflicting, and changing commitments, capacities, and

accountabilities which, in turn, can affect collaborative dynamics and outcomes (Lee, 2022; Romzek et al., 2014).

In sum, these lines of theory and practice help: 1) describe how collaboratives adapt their structures and process to internal and external changes; 2) understand the forces and factors that facilitate or frustrate adaptation; 3) identify actions and adaptations needed to support continued progress and evolution towards shared goals; and 4) develop and test assumptions about the configuration of, and interactions between, factors thought to measure collaborative governance and adaptability. Each chapter of my dissertation further elaborates on the relevant theoretical frameworks deployed therein. Below, I include an overview of the present study and a roadmap to the rest of the dissertation.

The work presented herein was co-developed with the Southwest Ecological Restoration Institutes (SWERI) and the Forest Service Forest, Range Management, and Vegetation Ecology program. In 2019, the Forest Service was tasked with developing their 10-year report to Congress to document findings from the first 10 years of the CFLRP relevant to the intent of the program.[2] The SWERI were asked to serve as subject-matter experts and participate in peer-learning sessions to distill findings and lessons learned about the collaborative approach embedded in the CFLRP. Additionally, the SWERI were asked to synthesize and report on lessons learned from the first 10 years of collaboration in the CFLRP (Beeton et al., 2020). A lingering question that emerged from the synthesis effort was the extent to which projects were resilient to change. This naturally funneled into the manuscript presented in chapter 2.

In chapter 2, published in *Journal of Forestry* (Beeton et al., 2022), I conducted a systematic review of peer-reviewed and grey literature, combined with focus groups at two cross-boundary

[2] CFLRP 10-year report to Congress: https://www.fs.usda.gov/restoration/documents/cflrp/REF_Report-CollaborativeForestLandscapeRestoration-508.pdf

collaborative workshops and a national survey on collaboration in the CFLRP to assess how collaboratives adapted to common disruptions they faced (i.e., turnover, biophysical, legal or policy changes) and what barriers constrained resilience. I developed a conceptual framework of the factors that affect collaborative resilience to situate the assessment. I found that collaboratives mobilized social capital, learning, resources, and flexibility to take collaborative actions and adapt to change, but a number of institutional, structural, and socio-interactional barriers constrained collaborative resilience, namely authority to act in the event of change, accountability of Forest Service staff to collaborative priorities, and limited capacity to engage. I emphasized that many of the barriers have been noted in the literature since the early 2000s and will need to be addressed to support healthy and resilient collaboration. I close with policy and practice recommendations to cultivate collaborative resilience.

In 2020, the Washington Office Forest Service Forest, Range Management, and Vegetation Ecology program worked with subject-matter experts and CFLRP coordinators at local and regional levels to develop the CFLRP Common Monitoring Strategy[3] for newly authorized and reauthorized CFLRP projects. Based on our previous work and continued engagement with the Forest Service, the SWERI were asked to participate as subject-matter experts to develop the Common Monitoring Strategy, and eventually to develop and deploy a program-wide and longitudinal collaborative governance assessment to address question 12 (*how well is the CFLRP encouraging an effective and meaningful collaborative approach*) of the Common Monitoring Strategy. The assessment was rooted in the theory and practice of collaborative governance and adaptability and informed by findings from the first 10 years of CFLRP. We deployed the baseline assessment as an online, confidential survey to all newly authorized and reauthorized projects (n=15) between 2021 and 2023. Chapters 3 and 4 report on baseline findings from this assessment.

[3] CFLRP Common Monitoring Strategy Fact Sheet: https://www.fs.usda.gov/restoration/documents/cflrp/CMS-Fact-Sheet-final-20221013.pdf

In chapter 3, in preparation for *Environmental Management*, I conducted a qualitative analysis of survey respondents' (n=168) recommended actions and adaptations to improve collaborative processes and continue making progress towards desired outcomes. I used a modified grounded theory approach, and I used components of the Integrative Framework for Collaborative Governance and organizational theory of change as sensitizing concepts to frame my analysis. I organized recommended actions and adaptations into seven themes:

- Maintain a forum for inclusive communication and dialogue throughout to develop shared understanding, priorities, and actions;
- Enact and periodically revisit clear, responsive, and accountable collaborative structures and processes;
- Maintain and enhance human, physical, and financial resources and capacity;
- Develop a culture of shared learning, monitoring, and adaptive management;
- Maintain or increase collaborative trust, working relationships, and broad commitment to collaboration;
- Outreach to the broader public for community buy-in, communication, and education of ongoing work; and
- Reduce barriers to implementation through local autonomy in decision making.

There were few differences between newly authorized and reauthorized projects in the actions and adaptations they recommended, and projects were simultaneously dealing with multiple challenges that, if addressed, could improve collaboration. I discussed these findings in light of collaborative governance theory and practice and included relevant resources and actions that practitioners and funders of collaboratives and policy actors could consider to support collaboratives in working towards forest and fire management objectives.

Chapter 4, in the second round of review in the *Journal of Environmental Management,* addressed several limitations of current quantitative research in the collaborative governance and adaptability space. I operationalized the Integrated Framework for Collaborative Governance developed by Emerson et al. (2012) and expanded on by Emerson and Gerlak (2014) in their assessment of adaptability in collaborative governance to test propositions set forth in the framework. I used confirmatory factor analysis to confirm the dimensional structure of collaborative governance and adaptability measures, and then tested the reliability and convergent, divergent, and criterion validity of the measures. I confirmed the components of collaborative governance and adaptability comprised six statistically reliable, valid, and distinct dimensions, including principled engagement, shared motivation, leadership, resources, knowledge and learning, and institutional arrangements. As expected, many of the dimensions were inter-related and the pattern of relatedness aligned with theory and practice. The findings indicated the assessment is a reliable and valid instrument that can be used to evaluate collaborative governance and adaptability within and between projects and through time, and can serve to address future research needs related to linking internal collaborative dynamics to outcomes.

Chapter 5 concludes with a summary of findings, policy and practice recommendations, limitations of the current research, and future research considerations. This work is supporting the standardized and longitudinal Forest Service CFLRP Common Monitoring Strategy. Consequently, the work presented herein established a baseline assessment and laid the scaffolding for a long-term social science research program to contribute to advancing the theory and practice of collaborative governance and adaptability.

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CHAPTER 2: CULTIVATING COLLABORATIVE RESILIENCE TO SOCIAL AND ECOLOGICAL CHANGE: AN ASSESSMENT OF ADAPTIVE CAPACITY, ACTIONS, AND BARRIERS AMONG COLLABORATIVE FOREST RESTORATION GROUPS IN THE UNITED STATES[4]

2.1 Introduction

The USDA Forest Service increasingly utilizes collaboration as a tool to meet national-level policy goals associated with forest restoration and wildfire risk reduction. The Collaborative Forest Landscape Restoration Program (CFLRP), for example, was established under the Forest Landscape Restoration Act in 2009, the purpose of which was to encourage the collaborative, science-based ecosystem restoration of priority landscapes on USDA Forest Service-managed lands (Schultz, Jedd, and Beam 2012). Projects were required to be developed and implemented collaboratively throughout planning, implementation, and monitoring (Butler and Schultz 2019). The CFLRP was innovative in that it mandated collaboration and provided a mechanism for sustained funding (Schultz, Jedd, and Beam 2012). It has also provided multiple opportunities for research that assessed the social and ecological outcomes of projects in unique places and contexts under the same policy instrument (Butler and Schultz 2019). There is increasing evidence that collaborative approaches have: supported restoration outcomes that approximate desired conditions (Barrett et al. 2021; Cannon et al. 2018); increased planning efficiency, acres treated, and diversity of accomplishments (McIver and Becker 2021); increased trust and capacity to accomplish work on the ground, while reducing conflict and litigation (McIntyre and Schultz 2020); and facilitated creative solutions to complex landscape scale management issues (Butler and Schultz 2019a).

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Yet, while evidence of the benefits of collaboration in publicly managed forests contexts continues to grow, less is known about how collaborative governance regimes (CGRs) adapt and remain resilient to disruptions that occur internally or among the social and environmental settings in which they are embedded (Cheng et al. 2015; Butler and Schultz 2019). This paper seeks to address this gap. Our analysis is informed by the following research questions:

1. What are the ways in which CGRs adapted to common disruptions, specifically personnel turnover, biophysical disturbances, legal challenges, or policy changes, that impacted their collaborative progress and performance; and
2. What barriers constrained CGR adaptation and resilience?

We assessed these questions within the context of CFLRP and other public forest restoration collaboratives across the United States. We reviewed and synthesized literature on the adaptability of CFLRP projects and coupled this review with examples from focus groups and a survey. We argue that while CGRs may demonstrate adaptability to myriad disruptions, there are persistent barriers that diminish CGR resilience.

2.2 Conceptual framework

The conceptual model in Figure 2.1 illustrates the factors that affect CGR resilience – a system's ability to buffer disturbance and adapt to social and environmental change without losing desired structure, function, and feedbacks – across scales (Walker et al. 2004). System context refers to the social, political, economic and ecological conditions in which CGRs are embedded. Disruptions among the system context and/or internal CGR changes, including biophysical disturbances (i.e., wildfire), policy changes (i.e., funding), and/or legal challenges (i.e., litigation) can impact collaborative progress and performance, thus forcing CGRs to adapt (Ostrom 2009; Emerson, Nabatchi, and Balogh 2012; Moseley and Charnley 2014).

CGR refers to "public policy or service-oriented, cross-organizational systems involving a range of autonomous organizations representing different interests and/or jurisdictions" (Emerson and Gerlak 2014: 769). Within the CGR, there are two components of the adaptation process – adaptive capacity (i.e., the preconditions necessary to prepare for and respond to social or environmental change) and the mobilization of those capacities to take adaptive actions (Emerson and Gerlak 2014; Smit and Wandel 2006; Nelson, Adger, and Brown 2007). Internal or external barriers can impede the adaptation process (Biesbroek et al. 2013; Moser and Ekstrom 2010). Adaptive capacities, actions, and barriers collectively determine whether desired outcomes are met and the extent to which CGRs are resilient (Emerson and Gerlak 2014; Turner et al. 2003; Figure 2.1).

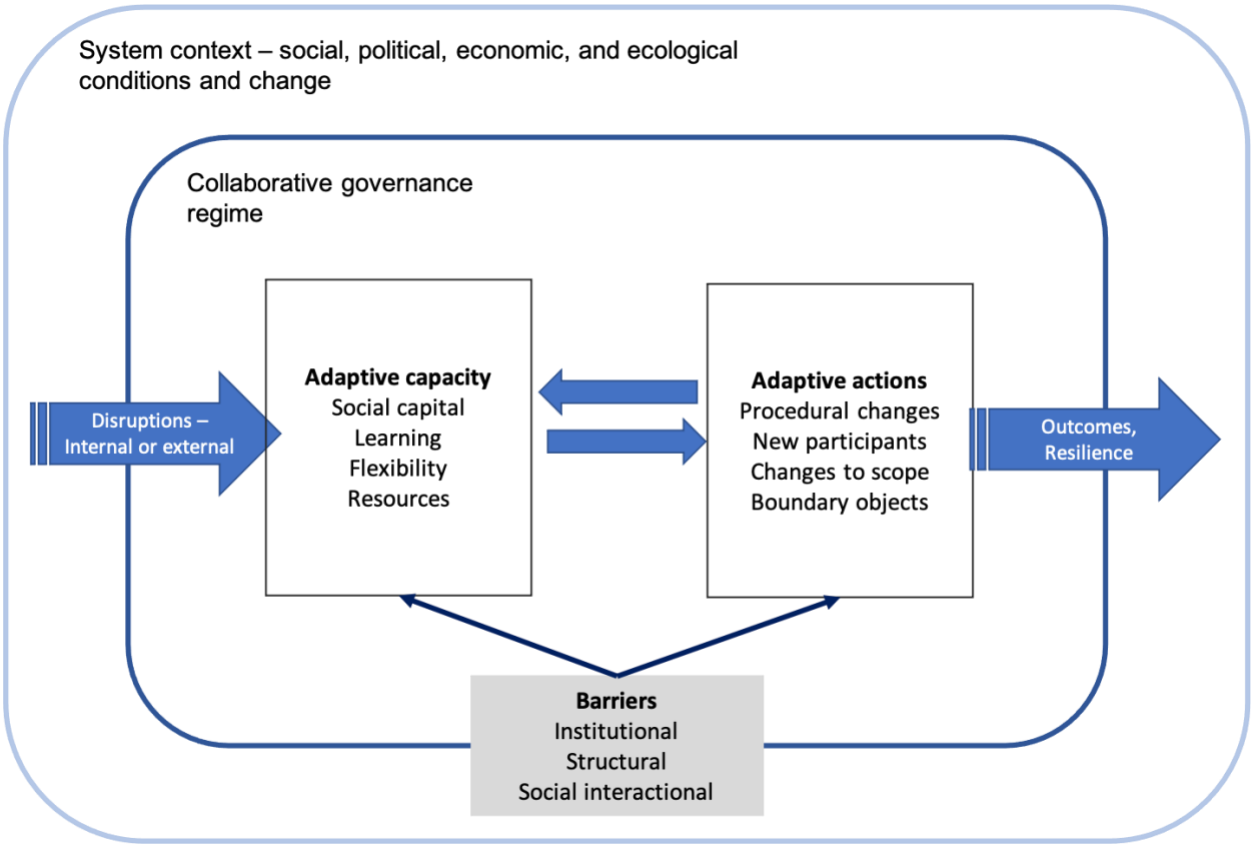

Figure 2.1. Conceptual model of the forces and factors that affect adaptation and resilience of collaborative governance regimes (CGR). CGRs are nested within the broader system context. Disruptions in the system context as well as internal disruptions can combine to expose collaboratives to potential vulnerabilities (and opportunities) that forces groups to adapt. The adaptation process is dependent on inherent adaptive capacities of CGRs (social capital, learning, flexibility, and resources) and the

mobilization of those capacities leading to adaptive actions. Adaptive actions can also feedback to affect and build adaptive capacity. Institutional and structural barriers act as impediments to the adaptation process. The combination of adaptive capacities, adaptive actions, and barriers determines the extent to which desired outcomes are met on the ground and the resilience of CGRs to ongoing and future disruptions, which may extend outside the CGR.

To promote collaborative resilience to disruptions, CGRs must enhance their adaptive capacity (Folke et al. 2010; Walker et al. 2004). Our review of the collaborative and adaptive governance literature identified several key factors, or determinants, that affect adaptive capacity and adaptive actions within CGRs, including: social capital, learning, flexibility, and resources (See Gupta et al. 2010; Hill 2013; Emerson and Gerlak 2014; Folke et al. 2005). These constructs were selected due to their prominence in the literature on CGRs engaged in collaborative restoration of publicly managed forests and the CFLRP in particular.

Social capital is the networks, norms, rules, and trust that promote collective action (Pelling and High 2005). It is considered "the glue" of adaptive capacity and is built through investments in social relationships (Folke et al. 2005). Networks are considered more adaptable when they are redundant, include a diversity of interests, perspectives, and knowledge, and when formal and informal arrangements are connected within groups (bonding capital), across groups (bridging capital), and across levels of authority (linking capital) (Gupta et al. 2010; Folke et al. 2005; Pelling and High 2005). Robust social capital can promote resource exchange, flexibility, and social learning (Pahl-Wostl 2009; Engle and Lemos 2010; Cinner et al. 2018; Koontz et al. 2015; Sharma-Wallace, Velarde, and Wreford 2018). Social capital is an important precondition for adaptive capacity, because without it, CGRs may struggle to effectively collaborate. For example, in collaborative restoration of publicly managed forests, turnover among agency and collaborative members that support the CGR can slow progress, undermine trust and relationship-building, and/or result in lost institutional knowledge or collaborative vision (Cheng et al. 2015; McIntyre and Schultz 2020; Santo et al. 2021; Coleman et al. 2021).

Learning is a key component of adaptive capacity (Berkes 2009; Pahl-Wostl 2009; Folke et al. 2005; Gupta et al. 2010). Social learning occurs through repeated interactions and joint problem solving among participants; it both enhances, and is influenced by, social capital (Lebel, Grothmann, and Siebenhüner 2010; Berkes 2009; Fernandez-Gimenez, Ballard, and Sturtevant 2008). It emphasizes testing, monitoring, and re-evaluating participants' held beliefs and understandings to co-produce knowledge of ecosystem dynamics, trends, and feedbacks to learn from and adapt to change (Folke et al. 2005; Lebel, Grothmann, and Siebenhüner 2010; Sharma-Wallace, Velarde, and Wreford 2018). Social learning can reduce conflicts and increase shared understanding, action, and trust (Lebel, Grothmann, and Siebenhüner 2010; Fernandez-Gimenez, Ballard, and Sturtevant 2008). Within forest management focused CGRs, learning is an important mechanism of collaboration. For example, field trips and joint fact-finding are considered key learning tools (Butler, Monroe, and McCaffrey 2015; Urgenson et al. 2017).

Adaptive CGRs have the flexibility to improvise and deploy alternative adaptation strategies (Engle and Lemos 2010; Cinner et al. 2018; Gupta et al. 2010). Multi-level social networks are thought to increase flexibility as diverse actors and organizations offer a diversity of authority, capacity, and solutions (Gupta et al. 2010; Folke et al. 2005). Robust structures and processes for learning allow CGRs to experiment with novel solutions and flexibly respond to known and unknown disruptions (Cinner et al. 2018; Gupta et al. 2010; Folke et al. 2005; Koontz et al. 2015). In the context of collaborative forest management, flexibility is incumbent due to frequently changing conditions on the ground (Spaeth 2014).

Resource availability is a key determinant of adaptive capacity (Smit and Pilifosova 2003; Emerson and Gerlak 2014; Eakin and Lemos 2006; Gupta et al. 2010). A benefit of CGRs is the ability to share and mobilize resources beyond a single organization's capacity. Shared resources can include funding, human capital, legal assistance, technical or scientific expertise, logistical or administrative

coordination, facilitation, and/or power (Emerson and Gerlak 2014). This is often supported by boundary-spanning individuals or organizations, including community champions, third-party facilitators or coordinators, and/or research organizations (Cheng et al. 2015; Hahn et al. 2006; Folke et al. 2005; Berkes 2009; Coleman, Stern, and Widmer 2017). In the context of the CFLRP, sharing resources is fundamental to the policy itself, and the Forest Service must leverage partner funds in addition to the funding received through the CFLRP.

Adaptive actions specific to CGRs may include changes in procedural rules or mandates, new participants, changes to the collaborative scope or mission, and/or the development or revision of a charter or mission (Emerson and Gerlak 2014). Adaptive actions may also support capacity-building (Hill and Engle 2015; Nelson, Adger, and Brown 2007). For example, field trips and/or informal social interactions can enhance trust and social learning (Wondolleck and Yaffee 2000; Figure 2.1). Boundary objects can absorb the social capital and learning developed by CGRs (Cheng et al. 2015; Cash et al. 2003; 2006; Feldman et al. 2006). Boundary objects are tangible items (e.g., models, assessment reports, implementation guidelines, or contracts) that exist between actors or organizations to facilitate group actions and interactions (Mollinga 2010; Star 2010), and help develop and codify shared understanding and transparency in decision-making (Cash et al. 2003; White et al. 2010; Cheng et al. 2015; Mollinga 2010; Westerink, Termeer, and Manhoudt 2020).

Institutional and structural barriers include limited coordination within and between organizations, inflexible policies and procedures, limited resources to plan and adapt to change; conflicting goals and missions, lack of leadership, or limited authority to act (Bierbaum et al. 2013; McNamara, Miller-Stevens, and Morris 2020; Wondolleck and Yaffee 2000; Margerum 2007; Moote and Becker 2003). Barriers may manifest from within or outside the CGR and can undermine social learning processes and trust-building, stifle flexibility, and impede actions (Walker and Hurley 2004; Munaretto and Huitema 2012; Gerlak and Heikkila 2011; Moser and Ekstrom 2010; Abrams et al. 2017) (Figure 2.1).

CGRs are nested within and do not replace traditional bureaucratic institutions (Agranoff 2006; Kettl 2006). The USDA Forest Service still retains decision-making authority over management actions, and thus can bound the latitude for adaptation (Nie 2004; Abrams et al. 2017).

2.3 Methods

2.3.1 Data collection

We addressed our research questions using a literature review and synthesis of the CFLRP literature on adaptability and barriers, coupled with case examples and exemplars from focus groups and a CFLRP survey. The literature review was carried out in two phases following systematic review and mapping principles to enhance transparency and reproducibility (James, Randall, and Haddaway 2016; Haddaway et al. 2016). Table 2.1 depicts the search sources, search terms or criteria used, and the number of retrieved documents for each phase. In phase 1, we re-analyzed a dataset the authors collected to support the USDA Forest Service in their CFLRP results and lessons learned summary series (The Authors 2020). This included a review of peer-reviewed and grey literature from the CFLRP Resource Library[5], and of an edited volume on collaborative governance dynamics in CFLRP projects (Butler and Schultz 2019). We compiled documents in the CFLRP Resource Library and "chased" relevant documents cited in the Resource Library for additional review (Jahangirian et al. 2011). Recognizing that the CFLRP Resource library is not a comprehensive resource for CFLRP literature, we conducted an additional review in Proquest (n=209) and Google Scholar (n=646 – we reviewed the first 200 entries, a common practice in systematic reviews) (Haddaway et al. 2015). In sum, the initial search yielded 474 documents for screening.

[5] https://www.fs.fed.us/restoration/CFLRP/resource-library.php

Table 2.1: Literature review search source, search terms or criteria, and number of retrieved documents.

Phase	Search source	Search terms or criteria	N
Phase 1	CFLRP Resource Library	Compiled all documents in CFLR Resource Library under “general” and “collaboration” theme, excluding news release, presentations, webinars	43
	Butler and Schultz (eds.), 2019		12
	Chased		10
Phase 2	Proquest	("Collaborative Forest Landscape Restoration Program" AND (governance OR adapt* OR respon* OR barrier* OR challenge* OR resilien*)) AND stype.exact("Conference Papers & Proceedings" OR "Reports" OR "Books" OR "Working Papers" OR "Scholarly Journals" OR "Dissertations & Theses")	209
	Google Scholar	"Collaborative Forest Landscape Restoration Program" AND (governance OR adapt OR adaptability OR adapted OR "adaptive capacity" OR respond OR responded OR barriers OR challenges)	646 (reviewed first 200 documents)
	Total		474

The exclusion process is illustrated in Figure 2.2. We first removed duplicates, followed by documents for which full-texts were not available, as well as press releases, national environmental policy act (NEPA) documents, book reviews, and presentations. Next, we surveyed document titles and abstracts to determine if the document: a) focused on a CFLRP CGR; and b) addressed our research questions. In cases where we were unable to determine this from the title or abstract, we skimmed the methods and results sections and used the advanced search function in Acrobat Pro DC using key word searches for a variety of terms related to our research questions and conceptual framework, including: “CFLRP”; “governance”; “collaboration”; “adapt”; “barrier”; “flexibility; “learning”; “turnover”; “beetle”; “wildfire”, among others. Finally, we excluded documents that provided no new empirical data, which

resulted in a total of 64 documents that were included in our analysis (Appendix 1). A list of documented reviewed but ultimately excluded from analysis are included in Appendix 2.

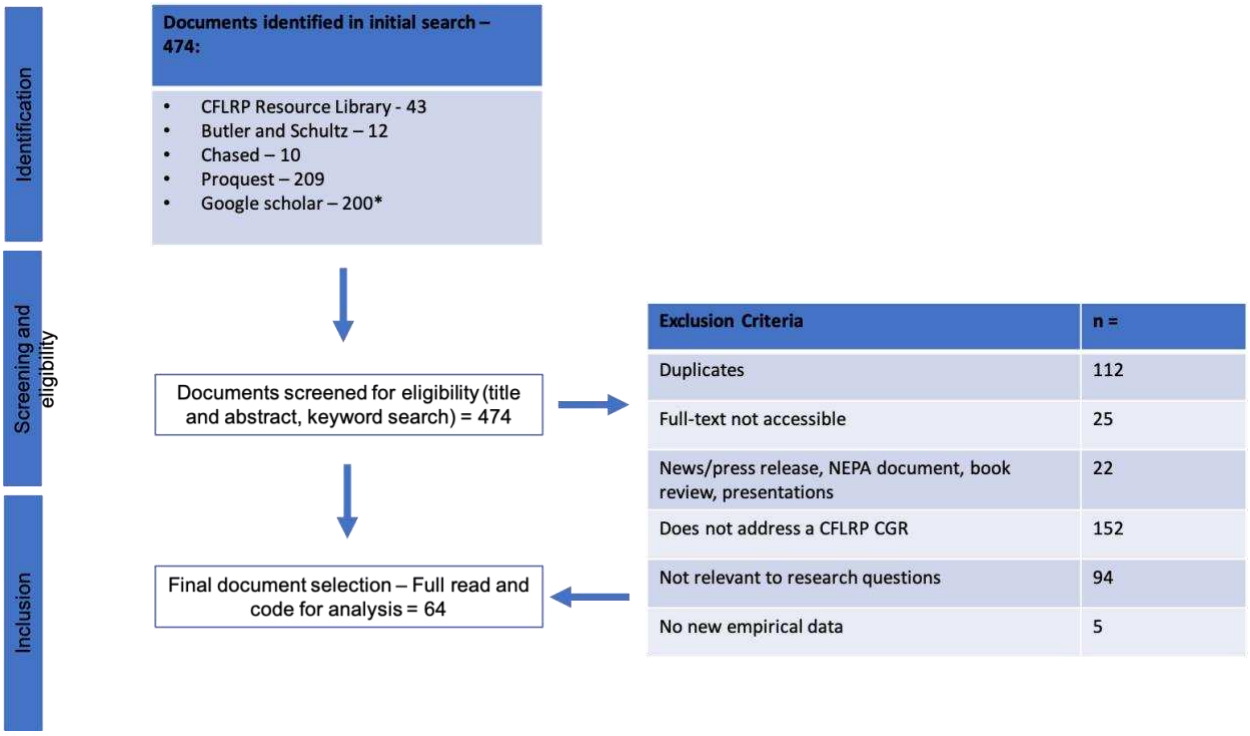

Figure 2.2. Literature review workflow including identification, screening and eligibility, exclusion, and inclusion. We searched multiple sources (CFLRP resource library, Butler and Schultz 2019 book chapters, Proquest, and Google Scholar). We reviewed the first 200 entries in Google Scholar, a common practice in systematic reviews and for secondary search engines (Haddaway et al. 2015). In sum, we screened 474 documents for eligibility. We followed a number of exclusion criteria to arrive at our final sample of 64 documents for full review.

We coupled this literature synthesis with case examples and exemplars from focus groups and a CFLRP survey on collaborative progress and performance. Focus groups were conveniently sampled at two forest collaborative workshops: the 2020 Southwest Ecological Restoration Institutes (SWERI) Cross-Boundary Landscape Restoration Workshop and the 2020 Idaho Forest Restoration Partnership Expanding Shared Stewardship workshop. Participants discussed changes their collaborative had experienced, adaptations, and barriers to adaptation (Appendix 3). Notes from focus groups were analyzed (n=7) as were responses from participants who volunteered to fill out a questionnaire on these

topics (n=45). We also analyzed a sub-set of responses from the CFLRP Collaboration Indicator Survey[6] administered by the National Forest Foundation in January 2020 to participants of the 23 CFLR projects (Figure 2.3), including collaborative participants and USDA Forest Service staff. We analyzed the open-ended questions addressing: adaptations (n=60); barriers to response (n=49); and regional office effects on CFLRP performance (n=59). Representatives from three CFLRPs did not answer these voluntary survey questions (Kootenai Valley Resource Initiative, Shortleaf Bluestem Community, Selway-Middle Fork Clearwater).

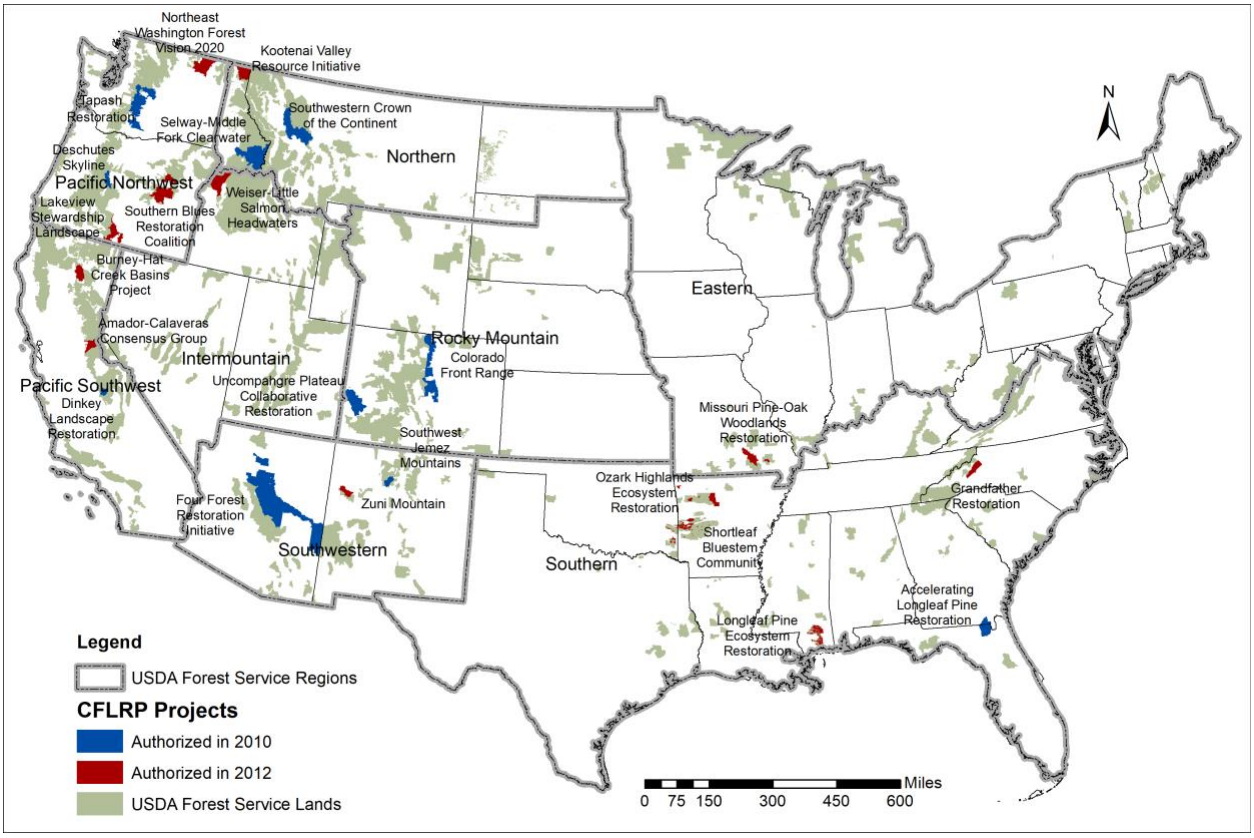

Figure 2.1. Map of Collaborative Forest Landscape Restoration Program projects. 10 projects were authorized in 2010 (blue) and 13 were authorized in 2012 (red).

2.3.2 Data analysis

[6] Results and raw data from survey can be found here - https://www.nationalforests.org/assets/pdfs/Collaboration-Indicator-Survey-Results-2020-publish.pdf

Each data source was analyzed in Atlas.ti using a modified grounded theory approach. Grounded theory is a process for analyzing qualitative data through an iterative, inductive process of coding, memoing, and constant comparison (Glaser and Strauss 1967). Modified grounded theory uses the same guidelines for analysis, but is neither purely inductive nor deductive (Charmaz 2006). Codes are derived inductively from analysis of data, as is the case with a grounded theory assessment, though the modified approach leaves room to situate the analysis within broader literature and theory (Mills, Bonner, and Francis 2006; Thornberg 2012).

We derived a priori codes from the concepts introduced in the conceptual framework and Figure 2.1 (e.g., adaptive capacity determinants, adaptive actions, barriers) to guide initial coding and analysis, and also derived codes inductively to ground our findings in the data. We situated our analysis on adaptations to common disruptions (personnel turnover, biophysical disturbance (specifically wildfire and/or pest or pathogen disturbances), legal challenges, or policy changes) and adaptation barriers. This assessment attempts to synthesize and report on some of the common responses and barriers that CGRs experienced and reported. As such, we hope the assessment may provide a menu of adaptation options for practitioners to consider.

2.4 Results

2.4.1 Adaptations to turnover

CGRs employed several strategies to adapt to turnover, including: 1) co-developing boundary objects to articulate collaborative vision, procedures, and agreements; 2) onboarding processes; and 3) spanning levels of agency authority to maintain collaborative philosophy (Table 2.2).

2.4.1.1 Co-developing boundary objects to articulate collaborative vision, procedures, and agreements

CGRs developed boundary objects, such as charters and memorandums of understanding or agreement (MOU/MOA) to articulate their collaborative vision, procedures, and expectations between collaborative members and among the USDA Forest Service. While these typically were not developed solely to

manage turnover, the literature and respondents considered them, and the processes used to create them, imperative for absorbing institutional memory and learning and for facilitating transparency and accountability following turnover (Cheng, Waltz, and Aplet 2019; Stern and Coleman 2019; USDA Forest Service 2021). As one respondent from the SWERI workshop noted,

> *if you have strong collaborative structure you shouldn't have to deal with this [turnover] because the expectations are clearly laid out in foundational documents.*

CGRs that formally developed and periodically revisited documents depicting operational rules and procedures that govern behavior, often through the use of a facilitator or coordinator to help develop and enforce them, adapted to turnover quicker and more efficiently when compared to CGRs that did not (Stern and Coleman 2019; Coleman and Stern 2018). In some cases, hand-over memos were used to inform new personnel of expectations and commitments (Butler and Schultz 2019a; Schultz et al. 2018).

Table 2.1. Adaptation to turnover themes by frequency of occurrence, example responses, and key citations.

Response type	Frequency of occurrence	Example responses	Key Citations
Co-developing boundary objects to articulate collaborative vision, procedures, and agreements	63	Document operational rules, procedures, and expectations of engagement from planning through to implementation; Document collaborative vision, and zones of agreement for restoration; Develop hand-over memos; Develop websites and repositories to house documents.	Schultz et al. 2017; Cheng et al. 2015, 2019; Butler and Schultz 2019; Stern and Coleman 2019; Antuma et al. 2014; USDA Forest Service 2021; NFF 2016
Onboarding activities	60	Redundant roles or continuity in roles; Onboarding workshops or meetings to review collaborative rules, procedures, and other documents; Additional time at meetings, field trips to build revisit rules and procedures	Antuma et al. 2014; Stern and Coleman 2019; Coleman et al. 2021; Butler and Schultz 2019; USFS 2018; Schultz et al. 2018; USDA Forest Service 2021; Cheng et al. 2019; Moote 2013

Spanning levels of authority to maintain collaborative philosophy	21	Encourage agency to fill vacancies, retain supportive leaders; Encourage leadership to communicate to line officers that collaboration was a priority; Participate in USDA Forest Service hiring process.	NFF 2016

Similarly, many CGRs have developed boundary objects for institutionalizing collaborative agreements regarding the principles of restoration and on-the-ground implementation activities (Cheng et al. 2015). For example, the Southern Blues created "decision trees," which delineated zones of agreement on the type, extent, and location of treatments and identified individuals to contact when issues arose (Antuma et al. 2014). A respondent from the Colorado Front Range CFLRP noted that general technical report (GTR) 373, which was collaboratively produced by the Colorado Front Range CFLRP, forest managers, scientists from the Rocky Mountain Research Station and Colorado Forest Restoration Institute, and environmental groups, helped articulate the CGR's vision for restoration following turnover.[7] Documenting field trips, meetings, and other collaborative engagements, along with personnel to manage, and websites to house, boundary objects helped to enhance transparency and onboard personnel (Antuma et al. 2014; USDA Forest Service 2021).

2.4.1.2 Onboarding processes

Several documents and respondents emphasized the importance of onboarding processes for adapting to turnover. Redundant, overlapping positions and responsibilities helped buffer impacts from turnover. In the Burney-Hat Creek Basins CFLRP, multiple USDA Forest Service staff participated in meetings to maintain continuity in the event of turnover and ensure broad agency understanding of collaborative expectations (USDA Forest Service 2021). Some CGRs required members to serve as alternates on leadership committees or as vice-chairs prior to serving the acting role. Others established formal

[7] Participant 22, NFF CFLRP Collaboration Indicator Survey

mentoring procedures wherein outgoing members recruited and trained their replacement (Coleman et al. 2021). Although not financially efficient, creating redundancy in positions, even for a short time, can help new members build trust and better understand group norms, thereby easing the transition (Stern and Coleman 2019; Coleman et al. 2021). The Southern Blues Restoration Coalition and Kootenai Valley Resource Initiative, hosted regular workshops or meetings to onboard new employees (Antuma et al. 2014; USDA Forest Service 2021; 2018). Respondents noted that changes in participant membership shifted from meeting to meeting. CGRs responded by spending more time at meetings to revisit rules, procedures, and to tell the collaborative story, and emphasized more time in the field together. Facilitators and coordinators were instrumental in coordinating these workshops and activities and (re)focusing the collaborative following transition (Moote 2013; USDA Forest Service 2018; Butler and Schultz 2019a; Cheng, Waltz, and Aplet 2019).[8]

2.4.1.3 Spanning levels of agency authority to maintain collaborative philosophy

The decision to engage with CGRs is often up to individual personnel in the USDA Forest Service. When agency personnel transitioned to another forest or position, CGRs sought support from agency leadership to ensure new personnel were aware of and committed to the project. This meant putting pressure on the USDA Forest Service at the unit- and regional-levels to align with collaborative priorities. In at least one instance, CGR members were involved in hiring for leadership positions (National Forest Foundation 2016). Often, vacant positions are not immediately filled after personnel transfer; thus, CGRs pressured leadership to fill vacancies and/or retain dedicated personnel:

> *The group continued to pressure the [USDA] Forest Service to either find replacements for positions that were vacated or to find ways to ensure longer-term employees to fill those vacancies.*[9]

2.4.2 Adaptations to biophysical disturbance

[8] SWERI Cross-boundary workshop breakout group discussion; Participant 16, SWERI Cross-boundary Workshop
[9] Participant 53, NFF CFLRP Collaboration Indicator Survey

We documented three adaptations to biophysical disturbance: 1) flexible institutions and arrangements; 2) living with and learning from disturbance; and 3) maintaining agency support for restoration goals following disturbance (Table 2.3).

Table 2.2. Adaptation to biophysical disturbance themes by frequency of occurrence, example responses, and key citations.

Response type	Frequency of occurrence	Example responses	Key citations
Flexible institutions and arrangements	40	Identify alternative planning units, treatment locations and types; Diversify or amend scopes of work, funding, timelines, partnerships, and/or priorities.	Spaeth 2014; Davis et al. 2019; Abrams et al. 2021
Living with and learning from disturbance	30	Monitor fuel treatment effectiveness and ecological response to disturbance; Monitor post-disturbance restoration alternatives to inform management actions; Field trips further supported understanding of desirable/undesirable disturbance effects, responses to management alternatives.	Wynecoop et al. 2019; Larson et al. 2013; Pile et al. 2019; Tabor et al. 2014; Watts 2019
Maintaining agency support for restoration goals	12	(Re)emphasize need for restoration to agency leadership following disturbance; Proactive discussions regarding post-fire response or recovery; Submit letter of support for post-disturbance environmental compliance.	

2.4.2.1 Flexible institutions and arrangements

CGRs demonstrated flexibility in responding to biophysical disturbances by altering treatment types, planning units, timelines, and/or priorities. Several CGRs developed agreements for salvage projects. For example, the 2012 Barry Point Fire burned four years of “NEPA-ready” restoration projects for the Lakeview Stewardship Landscape. The group subsequently agreed to salvage operations that limited

undesirable ecological effects and provided economic recovery and identified a new planning unit that included changes to CFLRP funding timelines, scheduling, and funding for reforestation (Spaeth 2014).

CGRs utilized innovative programs, authorities, and partnerships to address the increased scale of insect disturbance. CGRs in Colorado, Montana, and Washington used the CFLRP and/or the Joint Chiefs' Landscape Restoration Partnership to fund landscape-scale restoration in areas impacted by the mountain pine beetle epidemic (Abrams et al. 2021). Some groups utilized other authorities or agreements with their networks, as one respondent noted:

> *We needed to do something and got all hands-on deck approval. This has led to several formal agreements (Good Neighbor Authority, water providers, private, etc.), which has resulted in accelerated work.*[10]

2.4.2.2 Living with and learning from disturbance to inform future actions

Biophysical disturbances supported learning about disturbance effects, restoration priorities, and ecological effects of alternative restoration strategies. The 2015 Canyon Creek Complex fire brought forward recurring tensions between timber-dependent communities surrounding the Malheur National Forest in Oregon and environmental groups around balancing salvage logging for economic recovery and maintaining habitat for woodpecker species of conservation concern. The Blue Mountain Forest Partners, Malheur National Forest, and Rocky Mountain Research Station embarked on a four-year experimental study to monitor woodpecker response to alternative harvest treatments. Partners used a geographic information systems (GIS) tool called FIRE-BIRD to inform transparent salvage prescription decisions that maintain woodpecker viability (Watts 2019). CGR members were involved in the study from conception, thus providing a sense of ownership of the data and legitimacy of the results, as exemplified by one respondent:

> *[This project will lead to] improved trust, and will give us real data to see if env[ironmental] concerns are real. [It] gave us a project that we feel invested in seeing to the end. Everyone is looking at the same science because we helped design the study.*[11]

[10] Participant 6, SWERI Cross-boundary meeting
[11] Group 9, Idaho Forest Restoration Partnership Meeting

Field trips further supported learning about disturbance impacts, the need for restoration, and ecological effects of management alternatives.

2.4.2.3 Maintaining agency support for restoration goals

Strong working relationships with USDA Forest Service personnel helped CGRs maintain support for collaborative restoration goals following disturbance:

> *We made it clear that the work planned prior to the large fire was still a priority and the USFS has since continued to push that restoration work forward.*[12]

Strong relationships with the USDA Forest Service enabled CGRs to weigh in on post-disturbance management actions. For example, the Payette Forest Coalition drafted a letter to the Forest Supervisor to ensure treatment objectives for the proposed action aligned with their priorities.[13]

2.4.3 Adaptations to legal challenges or policy change

CGRs adapted to legal challenges or policy changes through: 1) flexible practices, processes, and/or operations; 2) collaborative learning; and 3) engaging objectors and intervening in court (Table 2.4).

2.4.3.1 Flexible practices, processes, and/or operations

CGRs developed multi-level collaboratives to match the scale of governance to the landscape-scale restoration requirements of the CFLRP. For example, the Southwestern Crown Collaborative linked three national forests, several community-based watershed groups, environmental groups, and research scientists, while the Deschutes Skyline project developed a "super-collaborative" that linked two existing CGRs (Monroe and Butler 2016; Tabor, Carlson, and Belote 2014).

Table 2.3. Adaptation to legal challenges or policy change themes by frequency of occurrence, example responses, and key citations.

Response type	Frequency of occurrence	Example responses	Key Citations

[12] Participant 55, NFF CFLRP Collaboration Indicator Survey
[13] Participant 6, NFF CFLRP Collaboration Indicator Survey; Participant 3, Idaho Forest Restoration Partnership

Flexible practices, processes, and operations	64	Partnerships and external funding to support treatment on private lands; Expanded group membership to formerly litigious or historically absent parties; Expanded the geographic scale or scope of CGR; Re-organized CGR structures to avoid FACA concerns.	Tabor et al. 2014; Monroe and Butler 2016; Butler 2013; Butler et al. 2015; Walpole et al. 2017; Bothwell 2019; Urgenson et al. 2017
Collaborative learning	40	Co-developed restoration principles and prescription guidelines; Developed agreement around science and models.	Monroe 2015; Moote 2013; Christenson and Bulter 2019; Vosick 2016
Engaging objectors and intervening in court	35	Engaged with potential litigators outside court; Supported USDA Forest Service as intervenors, friends of the court in litigation.	USDA Forest Service 2021; Vosick 2016; Antuma et al. 2014; Spaeth 2014; Bothwell 2019; McIntyre and Schultz 2020; Schultz et al. 2017

Some groups were challenged on alleged Federal Advisory Committee Act (FACA) violations. A collaborative group must be authorized as a FACA committee if a federal agency establishes and controls the group, it consists of non-federal entities, and it provides collective advice to the federal agency (Butler 2013). Hence, CGRs adjusted how USDA Forest Service staff participated in the collaborative process to eliminate any real or perceived collusion. The Southwestern Crown Collaborative, for example, revised their structure and removed USDA Forest Service personnel from leadership positions to ensure compliance (Butler 2013; Monroe and Butler 2016).

CGRs invited participation from litigious parties and/or participants who were historically absent from collaborative engagement to improve support for recommended actions (Antuma et al. 2014; Monroe and Butler 2016; Urgenson et al. 2017; Walpole et al. 2017; McIntyre and Schultz 2020). Diverse representation early in the process helped avoid conflict later, and even when groups don't participate, inviting them early in the process often eased conflict and increased support for decisions (Bothwell 2019; Urgenson et al. 2017). As with turnover, inviting formerly litigious groups or conflicting parties was

mediated by established rules and procedures that governed behavior and dedicated facilitators (Walpole et al. 2017).

The Mexican-spotted owl injunction in the Southwestern Region (Figure 2.1) halted all timber management activities on five national forests in New Mexico and one in Arizona in 2020. This forced CGRs to be flexible and engage with networks across boundaries to keep restoration work going and mills running during and post-injunction. The Forest Stewards Guild Youth Corps and Zuni Mountain CFLRP worked with private landowners and the State of New Mexico for administrative clearance to conduct prescribed burns on private lands. As one member remarked:

> *We proved the value of our youth fire crew and the program's ability to be nimble [and] we now have a strategy and precedent to deal with similar problems [in the future].*[14]

2.4.3.2 Collaborative learning

Many CGRs engaged in collaborative learning and fact-finding to reduce conflict and litigation. In the Sierra National Forest, restoration projects were embroiled in conflict and litigation for several years due to concerns regarding habitat suitability of Pacific fisher (*Martes pennanti*). The Dinkey Landscape Restoration project used GTR-220 (North et al. 2009) to reach consensus among conflicting parties around the purpose, need, and approach for restoration in fisher habitat (Moote 2013). Subsequently, the group co-developed tree marking guidelines and ladder fuels management strategies in Pacific fisher and spotted owl habitats, deployed a field monitoring program, and hosted field trips to support learning and engagement. The guidelines were adopted by the USDA Forest Service and formally integrated into environmental assessments and decision-making (Christenson and Butler 2019). Further, agreed-upon science carried out by the Tall Timbers Research Station and Land Conservancy in Florida, combined with trust in the Ecological Condition Model (ECM) for informing decisions has helped deter litigation in the Accelerating Long Leaf Pine Restoration CFLRP (Monroe 2015).

[14] Participant 29, SWERI Cross-Boundary Workshop

The Four Forests Restoration Initiative (4FRI) stakeholder group spent five years collaborating on the first 4FRI Environmental Impact Statement. Although the EIS was developed collaboratively, several litigious parties declined to contribute, and hence the threat of litigation was significant. One approach the stakeholder group used to stave off objections and litigation was to assess the extent to which the draft EIS sufficiently addressed standards and processes commonly objected or litigated. This signaled to those paying attention to the CGR, but not contributing, that the EIS was compliant, and although there were nine objections during the pre-decisional objection process, those were mitigated and the record of decision was signed in 2015 (Vosick 2016).

2.4.3.3 Engaging objectors and intervening in court

In situations in which litigious groups declined to participate, community champions and environmental organizations with strong relationships with potential litigators acted as intermediaries to find agreement and avoid litigation on salvage projects (Antuma et al. 2014; Spaeth 2014). CGRs also assisted the USDA Forest Service by submitting letters of support for projects, participating in the pre-decisional objection process, and/or intervening in court (Vosick 2016; Schultz et al. 2017; McIntyre and Schultz 2020; Bothwell 2019).[15]

Two partners of the Weiser-Little Salmon Headwaters CGR, Adams County and the American Forest Resource Council, served as intervenors on behalf of the CGR (USDA Forest Service 2021). In other cases, CGRs filed amicus briefs on behalf of the agency (McIntyre and Schultz 2020; Schultz et al. 2017).[16] Together, these actions have helped deter litigation, reduce the time spent on deliberation and objection processes, and signaled to potential litigators that the CGR supported the USDA Forest Service.

2.4.4 Barriers

[15] Participant 9 and 27, NFF Collaboration Indicator Survey
[16]Group 5, Idaho Forest Restoration Partnership Summit

CGRs dealt with the following barriers: 1) agency culture, commitment, and collaborative incentives; and 2) resource constraints.

2.4.4.1 Agency culture, commitment, and collaborative incentives

The USDA Forest Service has a culture of regularly rotating personnel (referred to as a "detail") to provide professional development and promotion opportunities. This culture of transition, coupled with lag times in filling vacancies, created challenges for CGRs, as illustrated by one respondent:

> *During the last two years, two District Rangers and the Forest Supervisor have either retired or moved. It took over a year to fill the Forest Supervisor position and now one of the new District Rangers is going on a detail after one year in her current position. These transitions are hard on collaborative groups as they must build new relationships and acting administrators aren't as empowered to move projects along towards implementation. This culture of moving employees to gain experience and get promoted is killing collaboration. It needs to change.*[17]

Rapid turnover also occurred among interdisciplinary teams within the timeframe of one project planning process (Schultz et al. 2018). This discontinuity undermined relationship and trust-building, and thus made it difficult to maintain momentum and a shared vision, and led to lost institutional knowledge (USDA Forest Service 2021; Cheng, Waltz, and Aplet 2019).

A lack of commitment to the collaborative process among decision-makers in the agency at unit- and regional scales was also a significant barrier (Bothwell 2019; Greer 2012). The literature we reviewed and respondents noted some line officers dismissed collaborative input or contradicted recommendations:

> *The [national forest] mostly stonewalls input from [the CGR], including suggestions on how projects could be changed to better restore ecological resilience.*

Bergemann et al. (2019) found differences in line officer support for collaboration across USDA Forest Service administrative units within a single CFLRP project. Similarly, respondents reported that some regional offices provided little support, developed initiatives without collaborative input, or were disconnected from CFLRP requirements and project-specific needs. Continued support garnered through

[17] Participant 9, NFF Collaboration Indicator Survey

past collaborative engagement was variable following transitions. While some CGRs were successful in maintaining existing collaborative restoration agreements vis a vis "zones of agreement," others found that progress derailed as new staff were not compelled to adhere to these agreements or expectations (Cheng, Waltz, and Aplet 2019; Christenson and Butler 2019; McIntyre 2019). Collaborative commitment varied depending on line officers' interpretations of overlapping laws and regulations, such as FACA or the tension to collaborate throughout the National Environmental Policy Act (NEPA) process while maintaining decision-making authority (Christenson and Butler 2019; USDA Forest Service 2021; Egan and Dubay 2013), and individual perceptions of the value of collaboration:

> *Forest Service culture limits the effectiveness of collaborative groups because many employees are unfamiliar with collaborative processes or [its] value.*

Agency staff also must adhere to multiple performance measures to track accomplishments. Yet, these performance measures are focused on outputs (e.g., acres treated), which often do not align with social and/or biophysical outcomes important to CGRs (e.g., treatment effectiveness), or agency targets (e.g., prescribed fire) may be more conservative than CGR goals (Butler and Schultz 2019; Cheng, Waltz, and Aplet 2019; McIntyre 2019). Particularly, performance measurements that incentivize collaboration are lacking:

> *Our current pay scale and organization doesn't answer to the increased capacity employees are expected to practice. A forester can do a quarter of the work on a different forest [non-CFLRP] and the only incentive to stay on the project is experience. This model is no longer effective.*[18]

In short, there are no formal accountability mechanisms to hold the USDA Forest Service accountable and committed to the collaborative process or inputs, which is exacerbated by turnover, especially since CGRs have no authority over who will be hired and when, and line officers have little incentive to go beyond their performance requirements and engage with collaboratives (Cheng, Waltz, and Aplet 2019; McIntyre 2019; Butler, Monroe, and McCaffrey 2015; Coleman et al. 2021; Greer 2012).

[18] Participant, 63, NFF Collaboration indicator survey.

2.4.4.2 Resource constraints

While sustained funding was generally reported as a contributing factor to CFLRP success, uncertainty in the amount and timing of funding, as well as restrictions on its use was considered a barrier (Bothwell 2019; Schultz et al. 2018; Treadaway 2013). Delays in executing grants and agreements affected the timing of dispersed funds and implementation timelines. CFLRP funding could only be used for monitoring and implementation, not for planning and collaborative activities (Schultz et al. 2018; Mattor 2013; Treadaway 2013), which further constrained CGRs:

> *The issue is not building relationships and spearheading the collaborations, but instead it's the lack of funding to sustain those relationships and collaboratives.*[19]

Lack of time to invest in collaboration among CGRs, external organizations, and agency personnel also constrained adaptive capacity (National Forest Foundation 2016; McIntyre and Schultz 2020). Some CGRs relied on a few key people—often volunteers—to carry out multiple tasks and found difficulty in recruiting and retaining unpaid leadership and staff (Schultz et al. 2018; USDA Forest Service 2021; Coleman et al. 2021). The partners they engaged with were often understaffed, further challenging resource investments in collaborative activities. For some agency staff, collaborative engagement was not part of their primary job requirements which, when combined with vacant positions, meant that agency staff were not always able to execute projects and meet stakeholder expectations (DuPraw 2014; Butler, Monroe, and McCaffrey 2019; McIntyre 2019; Schultz et al. 2018; Treadaway 2013; Egan and Dubay 2013; Schultz, Coelho, and Beam 2014).

2.5 Discussion

2.5.1 Adaptability and action in the face of change

This article assessed how CGRs mobilized adaptive capacity to three common disruptions – personnel turnover, biophysical disturbances, and legal or policy changes. We situate our discussion within the

[19] Breakout group 3, SWERI Cross-boundary Workshop

theorized determinants of adaptive capacity presented in the conceptual framework (social capital, social learning, flexibility and resources).

Regarding social capital and learning, CGRs facilitated dialogue and engaged in field trips, onboarding workshops, joint fact-finding, multi-party monitoring, and adaptive management. These activities helped build trust and relationships across networks to reach consensus about the purpose and need for restoration, evaluate the impacts of biophysical disturbance and treatment alternatives, and temper conflict between differing objectives. Strong linking social capital (Pelling and High 2005) with forest leadership was critical in maintaining support for collaboration amid turnover and biophysical disturbance.

The co-development of, and interaction with, boundary objects helped CGRs translate this learning and social capital into codified expectations and responsibilities amid turnover (e.g., MOUs, charters). Documents (e.g., GTRs) and engagement with models (e.g., ECM) were key to institutionalizing collaborative vision and recommendations, capturing learning from biophysical disturbances to inform management decisions, and reducing conflict and litigation through CGR transitions. Boundary-spanning individuals and organizations provide resources and support functions (Folke et al. 2005; Colavito 2019). In the CGRs analyzed here, these individuals and organizations facilitated the development of boundary objects and supported onboarding activities, supported CGRs in legal matters, and provided scientific expertise for monitoring and informing restoration strategies.

CGRs also demonstrated flexibility. They developed agreements across boundaries to maintain restoration work despite an injunction, changed their structure and function to accommodate new policy requirements, and diversified funding resources and existing agreements to match the scale of disruptions with the scale of restoration.

2.5.2 Institutional and structural barriers bound adaptation actions

Yet, the confluence of three components – authority, accountability, and capacity – created barriers to CGR resilience. Even with CGR attention to managing turnover, the agency culture of rotating personnel and limited capacity to fill vacant positions undermined collaborative engagement. It takes time to build trust, personal relationships, and understanding of the social and ecological context in which CGRs are embedded (Moote and Becker 2003; Santo et al. 2021; Coleman et al. 2021). Yet, CGRs have no formal authority to influence if or when USDA Forest Service personnel transfer to other positions.

In some cases, low commitment to collaboration at local and regional levels constrained collaborative engagement and their influence on management decisions. Sharma-Wallace (2018) found that consultation without substantial engagement of collaboratives in informing decisions diminished long-term governance outcomes. The USDA Forest Service gives local leadership considerable autonomy in decision-making. Decisions are made based on individual interpretations of, and support for, policy initiatives, as well as local capacity and culture (Moseley and Charnley 2014). Decision-makers must also navigate multiple and potentially conflicting rules, regulations, procedures, and performance measures that can affect whether and to what extent collaboratives are engaged and inform management actions (Biber 2008). Collaborative engagement often increases agency personnel workload and is difficult to encourage when few incentives exist (Moote and Becker 2003; Agranoff 2006; Biber 2008).

Thus, CGRs often must persuade individuals to remain accountable to the collaborative process – our results demonstrate success was variable. Reliance on individual commitment to collaboration was complicated by frequent turnover, as CGRs must build relationships with new staff and re-negotiate commitments, expectations, and accountabilities (Orth and Cheng 2019; Coleman et al. 2021). This diminishes the ability of CGRs to maintain social capital across levels of authority and influence (Pelling and High 2005). While leaders are key to legitimizing collaboration and promoting adaptability (Olsson et al. 2006; Westley et al. 2013), reliance on individual leaders leaves CGRs vulnerable, as it can signal that collaboration is not yet institutionalized (Cheng, Waltz, and Aplet 2019). Further, resource constraints in

personnel and funding inhibited the ability of participants to engage in the CGR and carry out their work. For example, CFLRP funding could not be used for collaborative planning and capacity-budling to support trust-building, conflict management, and learning, which are necessary to support resilience. Similar barriers have been noted since the late 1990s and early 2000s (Wondolleck and Yaffee 2000; 1997; Moote and Becker 2003). Policy initiatives that require collaboration in public lands management are unlikely to sustain resilient CGRs until these barriers are addressed. We provide several policy and practice recommendations to enhance CGR resilience below.

2.5.3 Policy recommendations

2.5.3.1 Expand funding for collaborative planning and capacity building

Activities that support social learning, conflict management, and relationship-building are critical for CGR adaptability. Support for and investment in leaders, facilitators, and science staff is necessary to sustain CGRs over time (Cheng and Sturtevant 2012; Colavito 2019). Our findings indicate that monitoring was key to helping CGRs learn from disturbance, deter litigation, and inform management decisions. Thus, funding for collaborative planning should not replace monitoring and implementation funding.

2.5.3.2 Change in agency culture and commitment to collaboration

Ensuring staff are dedicated to collaborative projects until completion, facilitating promote-in-place opportunities, and/or hiring dedicated partnership liaisons to manage relationships could help address turnover. Also, including expectations for collaboration in job requirements and evaluations and requiring collaboration training would facilitate the development of personnel with skills, interests, and commitment to collaboration (Schultz et al. 2017; Butler and Schultz 2019).

Particularly important is the development of agency performance measures for collaborative engagement. Performance measures should be easy to measure and communicate, complementary, and seen as priorities (Biber 2008; Schultz, Moseley, and Mattor 2015; Santo, Bertone-Riggs, and Huber-Stearns 2020). Personnel shortages and budget constraints may hinder the ability of agency

professionals to assess collaborative performance and integrate results into decision making (Wurtzebach et al. 2019), while internal performance measures may do little to improve agency accountability and responsiveness to CGRs (Schultz, Moseley, and Mattor 2015). Including external reviews from non-agency stakeholders involved in CGRs as part of forest unit performance evaluations could incentivize personnel to invest time and resources in collaboration (Cheng, Waltz, and Aplet 2019).

2.5.4 Practice recommendations

2.5.4.1 Co-develop and periodically revisit boundary objects

Sustaining the co-development of and engagement with boundary objects is important for restoration practitioners to build trust, absorb learning, and sustain institutional knowledge (Cash et al. 2003; Cheng, Waltz, and Aplet 2019; Stern and Coleman 2019). Whenever possible, boundary objects should be situated within agency decision-making procedures, which may reduce reliance on individuals and encourage accountability (Cheng et al. 2015; Urgenson et al. 2017). With new personnel, CGRs and supporting entities negotiate responsibilities, accountabilities, and capacities (Orth and Cheng 2019). Thus, boundary objects should be periodically reviewed to maintain legitimacy, saliency, and credibility (Cash et al. 2003; Cheng et al. 2015).

2.5.4.2 Conduct frequent self-assessments of collaborative resilience

CGR adaptability is context- and time-dependent (Smit and Wandel 2006). CGRs can experience external or internal disruptions at any time, which can expose groups to new vulnerabilities and opportunities. The challenge is for CGRs to be prepared for and enhance the capacity to deal with both known and unknown disruptions (Berkes 2007). Further, CGR structure, function, and capacity may evolve (Salerno et al. 2021; Ulibarri et al. 2020). Therefore, CGRs should routinely self-assess the disruptions to which they are exposed, and both short-term and long-term adaptations for collaborative resilience.

2.6 Conclusion

The USDA Forest Service and policies like the Collaborative Forest Landscape Restoration Program (CFLRP) continue to encourage collaboration to advance wildfire risk reduction and forest restoration goals. Yet, research on how collaborative governance regimes (CGRs) adapt and remain resilient to disruptions is underexplored. Using the case of the CFLRP and other public forest CGRs, this study assessed: 1) how CGRs adapted to internal and external disruptions; and 2) what barriers constrained CGR resilience. Many CGRs exhibited high adaptability by building social capital and trust, engaging in social learning, and demonstrating flexibility to adjust response options and manage relationships among diverse actors. Still, several barriers, including: agency culture, commitment, incentives, and resource constraints complicated collaborative resilience. These barriers undermined CGR authority to influence actions, limited staff capacity to engage in collaborative efforts, and diminished agency accountability to collaboratives. We identified policy and practice recommendations to increase CGR resilience and continue to meet the national policy goals they are intended to support.

An important study limitation should be noted. The analysis was a point-in-time assessment, a common limitation of collaborative governance research (Ulibarri et al. 2020). To address this, future work should assess how forest collaboratives evolve through time and adapt collaborative structures, processes, and practices to multiple stressors. Additionally, larger sample systematic studies are needed to complement the rich case study literature and provide evidence base for comparisons across cases, contexts, and scales. One approach being explored is to build surveys for CFLR participants in ongoing monitoring protocols to support social learning among CGRs and identify where changes are needed to support adaptive management.

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CHAPTER 3: RECOMMENDATIONS TO IMPROVE COLLABORATIVE PROCESSES AND PERFORMANCE IN COLLABORATIVE FOREST LANDSCAPE RESTORATION PROGRAM PROJECTS[20]

3.1 Introduction

Collaborative environmental governance approaches are lauded as an alternative approach to traditional, top-down hierarchical governance regimes. Claimed benefits of collaboration include enhanced efficiencies and the potential for flexible and innovative solutions, increased trust and support for management actions among partners, joint knowledge development, and social learning (Agranoff, 2006; Ansell and Gash, 2007; Emerson et al., 2012; Wondolleck and Yaffee, 2000). The increased interest and demand for collaborative approaches among public land management agencies, like the U.S. Department of Agriculture Forest Service (Forest Service), emerged in the 1990s in response to increasing legal concerns, as well as regulatory and bureaucratic challenges (Cheng and Sturtevant, 2012; Koontz et al., 2020; Schultz et al., 2021; Wondolleck and Yaffee, 2000). In particular, declines in organizational capacity, legitimacy, autonomy, and discretion, coupled with the need for innovation and the rise of the ecosystem management approach together spurred both grassroots, community led movements and top-down direction aimed at increasing collaboration among public and private entities and individuals to meet growing wildfire and forest management concerns that could not be achieved alone (Abrams, 2019; Wondolleck and Yaffee, 2000). The Forest Service continues to direct programs and funding to collaboration to address national forest and fire management challenges, including the Healthy Forests Restoration Act of 2003, the Forest Landscape Restoration Act (FLRA) of 2009 which authorized the Collaborative Forest Landscape Restoration Program (CFLRP), the Natural Resources

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Conservation Service and Forest Service Joint Chiefs' Landscape Restoration Partnership, and Shared Stewardship (Cyphers and Schultz, 2019; Kooistra et al., 2022; Schultz et al., 2012).

Collaboration is a dynamic and evolving process. People come to the collaborative table with different motivations, expectations, accountabilities, and capacities to engage (Davis et al., 2017; Lee, 2022). Further, collaborative networks create value in different ways as they evolve, and thus collaborative priorities and resources required are context- and time-dependent (Imperial et al., 2016). Hence, there is a need for periodic evaluation of how collaboration is working in local contexts, whether member expectations are being met, and what participants need to improve the collaborative process and progress.

The Forest Service Forest, Range Management, and Vegetation Ecology staff asked the authors to develop and administer a longitudinal assessment as part of the CFLRP Common Monitoring Strategy to track collaborative governance and progress among all newly authorized and reauthorized CFLRP projects (Figure 3.1).[21] The purpose of the CFLRP was to support collaborative restoration in high priority landscapes using science-informed ecological restoration principles (Schultz et al., 2012). Project participants are mandated to collaborate throughout planning, implementation, and monitoring. However, collaboration was not defined in either the CFLRP or FLRA, nor was there guidance on how collaboration should be developed and deployed in local contexts. Thus, collaborative structures and processes that guide project partners in many ways are unique to the socio-economic, political, and historical milieu of local communities, but are situated within the same policy instrument and represent a unique opportunity to study collaboration in a naturalistic experimental setting (Schultz et al., 2018). In this paper, we present baseline results of our qualitative analysis, the purpose of which is to describe

[21] https://www.fs.usda.gov/restoration/documents/cflrp/CMS-Fact-Sheet-final-20221013.pdf

CFLRP project respondents' recommended actions and adaptations to improve collaborative processes and progress towards desired forest and fire management outcomes.

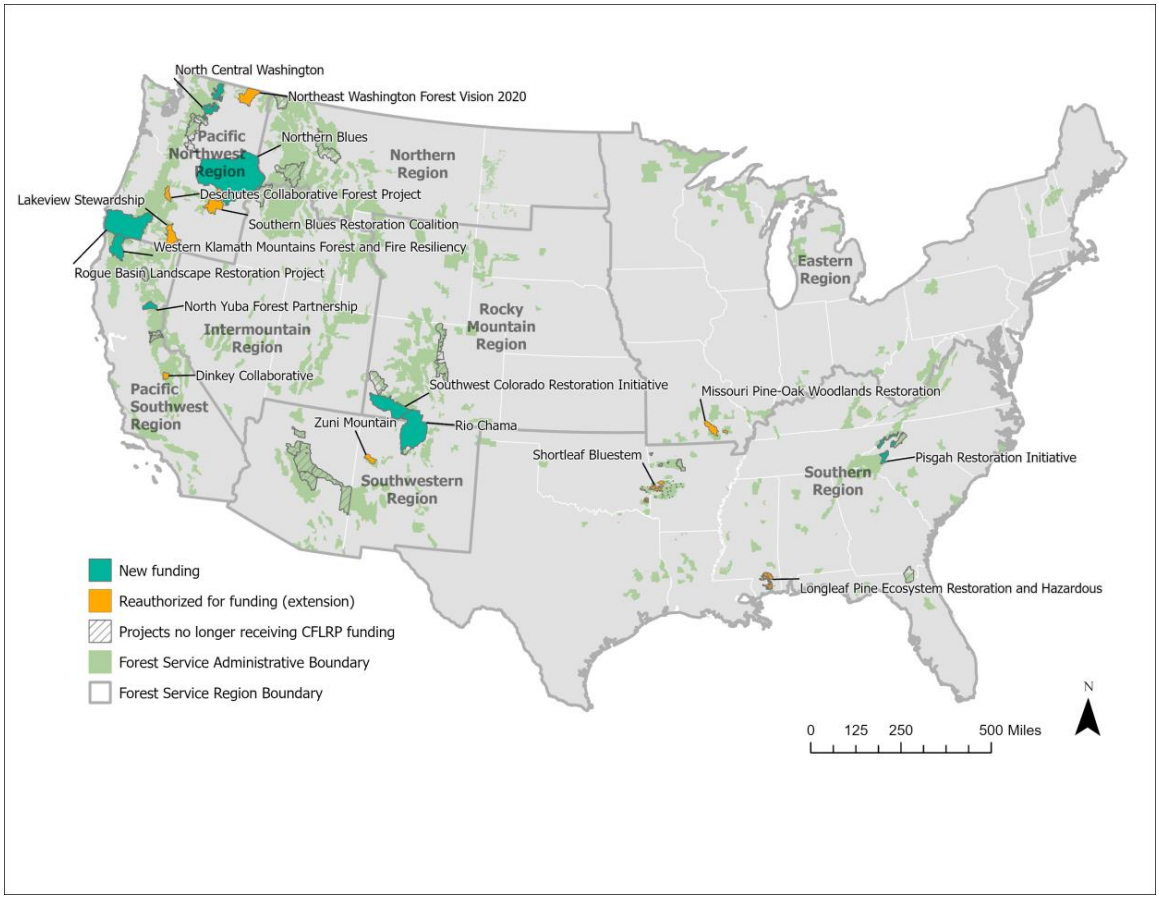

Figure 3.1. Map of CFLRP projects. Projects no longer receiving funding (hatched) first received funding in 2010-2013 for 10 years. Newly authorized and extension projects are depicted in green and orange, respectively. Map Credit: Anthony Martin, Colorado Forest Restoration Institute.

3.2 Literature review – Collaborative governance, adaptation, and evolution

Emerson et al. (2012) define collaborative governance as "the processes and structures of public policy decision making and management that engage people across the boundaries of public agencies, levels of government, and/or the public, private for-profit, and civic spheres to carry out a public purpose that could not otherwise be accomplished" (p. 2). Their Integrative Framework for Collaborative Governance compiles over 30 years of research and practice in collaborative governance from a variety of fields. Emerson et al. (2012) postulate that collaborative governance constitutes a nested set of interactions

between the external social-ecological context (e.g., legal, policy directions; biophysical conditions; economic livelihoods), internal collaborative processes, structures and the actions collaborative members take, which, in turn, result in impacts and adaptations to the collaborative governance regime and broader social-ecological context.

Emerson et al.'s (2012) framework includes multiple sub-components of collaborative dynamics. Principled engagement refers to including a representative set of interested and affected parties in the collaborative with venues for communication and dialogue to move towards shared understanding of the key problems (e.g., forest conditions that are severely departed from desired conditions), strategies to address key problems, and the collaborative purpose. Shared motivation refers to the relational components of collaboration and includes building trust, working relationships, and internal legitimacy among members who are committed to collaboration. Capacity for joint action includes four sub-elements: financial, human, and physical resources; leaders who work well with others and bring groups together to accomplish shared work; mechanisms for joint learning, information sharing, and adaptive management; and institutional arrangements - i.e., processes and procedures that structure collaborative engagement and decision-making - that are fair, transparent, responsive, and accountable. Importantly, entities engage in collaboration with different motivations, expectations for how collaboration should work and the outcomes it should produce, commitments, and capacities (Bryson et al., 2006; Davis et al., 2017; Genskow, 2009; Lee, 2022). Further, overlapping and sometimes conflicting accountabilities among parent organizations, funders, and the collaborative may mean that participants are unable to engage in ways that meet partner expectations, which, in turn, may affect perceived collaborative progress and performance (Lee, 2022; Romzek et al., 2014; Waardenburg et al., 2020).

Collaboratives produce a number of actions, impacts, and adaptations throughout their lifecycle (Emerson et al., 2012; Imperial et al., 2016; Ulibarri et al., 2020). Collaborative actions include developing and applying monitoring practices, securing resources to plan and implement projects,

and/or developing a novel management approach, whereas impacts include social-economic and ecological outcomes of collaborative work (Emerson et al., 2012). Adaptations refer to adjustments that are made in response to changes in collaborative processes, actions, outcomes, or the system context in which collaborative governance regimes are embedded. For example, a group may expand its collaborative goals and functions to take advantage of new funding opportunities, or it may augment planning areas and implementation strategies due to a biophysical disturbance (Beeton et al., 2022; Cheng et al., 2015). The necessary actions and adaptations considered by collaboratives, and the resulting impacts on the ground are dynamic. They depend on the specific collaborative context, makeup of interested and affected parties and the resources at their disposal, and will change through time (Imperial et al., 2016). Collaboratives also require different resources and support as they evolve such that the relative importance of collaboration dynamics and their interactions should be context- and time-specific (Imperial et al., 2016; Ulibarri et al., 2020). We use the concepts presented briefly here as sensitizing concepts to situate our analysis below (Bowen, 2006).

3.3 Methods

3.3.1 Data Collection

We administered a confidential survey in the online platform Qualtrics (https://www.qualtrics.com/) to 15 newly authorized and reauthorized CFLRP projects. Two additional projects were authorized for funding after our survey recruitment closed, and thus are not represented in our survey and results (Table 3.1). The survey consisted of fixed-response statements using a bipolar 5-point Likert scale and open-ended questions. All questions were voluntary and respondents had the option of choosing "I don't know." The survey addressed four research questions:

1. Do participants feel the collaborative exhibits characteristics generally associated with healthy, well-functioning, and resilient collaboration?

2. To what extent do participants feel the CFLRP project is meeting process, socio-economic, and ecological goals?
3. What do participants need or recommend to improve the collaborative process and continue making progress?
4. What challenges or disruptions have affected collaborative performance and durability? And how have collaboratives adapted to those challenges?

This paper analyzes open-ended responses to what respondents needed or recommended to improve the collaborative process and continue making progress. We worked with key points of contact for each of the fifteen CFLRP projects – e.g., coordinator, facilitator, executive committee members – to determine recruitment and administration procedures. We strove for a complete census of CFLRP participants who were engaged and knowledgeable about the collaborative process (Bernard and Gravlee, 2015), and we leaned on points of contact to recruit participants through their project and partnership listservs. The number of participants for each CFLRP project varied, and so did our recruitment pool (from 37-205), which reflects the differences in how projects are structured and operate under the CFLRP.

Table 3.1. CFLRP project characteristics. The Longleaf Pine Ecosystem Restoration and Hazardous Fuels Reduction and Pisgah Restoration Initiative CFLRP projects were authorized after we administered our survey, and thus are not included in our survey or results.

Project Name	New or reauthorized	State(s)	Forest Service Region(s)	# of Forest units	CFLRP Acres	% Forest Service-managed land
Deschutes Collaborative Forest Project	Reauthorized	OR	6	1	257,548	80%
Dinkey Collaborative	Reauthorized	CA	5	1	154,000	84%
Lakeview Stewardship	Reauthorized	OR	6	1	859,288	77%
Longleaf Pine Ecosystem Restoration	Reauthorized	MS	8	1	426,746	89%

and Hazardous Fuels Reduction						
Missouri Pine Oak Woodlands Restoration	Reauthorized	MO	9		444,879	28%
North Central Washington	New	WA	6	1	1,148,355	Majority Forest Service
North Yuba Forest Partnership	New	CA	5	2	356,000	74%
Northeast Washington Forest Vision 2020	Reauthorized	WA	6	1	916,000	55%
Northern Blues	New	OR; WA	6	2	10,426,560	37%
Pisgah Restoration Initiative	New	TN	8	2	945,985	58%
Rio Chama	New	CO; NM	2, 3	4	3,773,247	51%
Rogue Basin Landscape Restoration Project	New	OR; CA	6	1	4,561,094	40%
Shortleaf Bluestem	Reauthorized	AR; OK	8	1	569,458	64%
Southern Blues Restoration Coalition	Reauthorized	OR	6	1	1,035,022	85%
Southwest Colorado Restoration Initiative	New	CO	2	1	1.909,586	91%
Western Klamath Mountains Forest and Fire Resiliency	New	CA	5	2	1,197,720	98%
Zuni Mountains	Reauthorized	NM	3	1	253,464	70%

The survey was first piloted with the Northern Blues CFLRP and All-lands partnership in November 2021. We used results from the pilot and feedback from respondents to refine the survey. The survey was then administered to the remaining fourteen projects between November 2022 and June 2023. We provided periodic updates to our points of contact regarding response rate and groups who had responded to the survey, and points of contact used this information to send out periodic reminders

to project members. We left the survey open for 4-10 weeks. In total, we received 341 usable responses to the survey (24% response rate), and we received 168 responses to the section on recommendations. This work was approved by the Institutional Review Board at Colorado State University (number 2679).

3.3.2 Data Analysis

Recommendations were analyzed in Atlas.ti using a modified (or sometimes referred to as "informed") grounded theory approach. Grounded theory in an iterative approach to analyzing data, which consists of several rounds open and axial coding, memoing, and constant comparison of codes and higher-order concepts (Corbin and Strauss, 2008). While traditional grounded theory assumes researchers go into data analysis *tabla rasa* (Glaser and Strauss, 1967), researchers frame their research and analysis based on prior experience, research background, and broader socio-environmental circumstances (Charmaz, 2011; Corbin and Strauss, 2008; Thornberg, 2012). Thus, some argue that a modified approach is appropriate, which uses the tenets and procedures of grounded theory as flexible guidelines, but is not purely inductive and, instead, relies on abductive reasoning and sensitizing concepts to frame analyses (Bowen, 2006; Charmaz, 2011). Codes and higher-order concepts can "emerge" from the data following the traditional grounded theory approach, but codes and concepts can be derived from, or tested against, relevant literature (Charmaz, 2011; Mills et al., 2006; Thornberg, 2012). We first conducted open, inductive coding of responses and used sensitizing concepts from the collaborative and network governance literature (Section 2), where appropriate, to inform our analysis.

3.4 Results

We received 168 responses and coded 228 recommendations. We organized the recommendations into seven themes in order of the frequency with which they were reported (Table 3.2). Appendix 4 includes the relative frequency with which each theme was mentioned by agency and non-agency respondents, newly authorized and reauthorized projects, and individual projects. "Inclusive engagement throughout the process" was most frequently mentioned by respondents in eleven projects, "institutional

arrangements" was most frequently mentioned in three projects, and "resources and capacity" and "trust, relationships, and commitment" were most frequently mentioned in one project. For each project, three or more themes were mentioned. This suggests they were dealing with multiple issues simultaneously that, if addressed, could improve collaborative progress and performance. "Inclusive engagement throughout the process" and "institutional arrangements" were most frequently reported among agency and non-agency personnel. Yet, non-agency respondents mentioned the need for additional "resources and capacity" relatively more frequently and the need for "inclusive engagement throughout the process" less frequently than agency personnel. Notably, none of the agency personnel recommended "external communication and outreach," while a small proportion of non-agency personnel did (7%). Reauthorized (i.e., extension) and newly authorized CFLRP projects most frequently recommended "inclusive engagement throughout the process," "institutional arrangements," and "resources and capacity." However, newly authorized projects mentioned the need for additional "resources and capacity" more frequently and the need for "inclusive engagement throughout the process" less frequently than did extension project respondents.

Table 3.2. Recommendation themes, description, frequency, and example recommendations for each theme.

Theme	Description	Frequency	Example recommendations
Inclusive engagement throughout the process	Maintain a forum for inclusive communication and dialogue throughout to develop shared understanding, priorities, and actions	87 (38%)	-Diverse and inclusive representation from under-represented groups in collaborative and leadership -Maintain or enhance frequency and content of meetings and field trips -Increase opportunities for honest dialogue and negotiation of different perspectives to identify shared priorities -More direct engagement of collaborative members throughout the planning and decision-making process -Enhance participation in cross-boundary planning and prioritization
Institutional arrangements	Enact and periodically revisit clear,	45 (20%)	-Develop, clarify, and revisit collaborative protocols, structures, and processes

	responsive, and accountable collaborative structures and processes.		-Maintain or enhance accountability, transparency, and responsiveness to collaborative input -Clarify roles, capacities, and expectations of collaborative members -Develop onboarding processes to get newcomers up to speed of collaborative protocols and context -Simplify or streamline collaborative processes and protocols -Develop consensus or modified consensus approaches -Enact term limits on leadership and committee positions to encourage diverse perspectives
Resources and capacity	Maintain and enhance human, physical, and financial resources and capacity	44(19%)	-Encourage continuity and redundancy in personnel to achieve collaborative objectives -Encourage support from boundary spanning organizations and individuals -Technical expertise -Third-party facilitation -Additional/supplemental funding streams -Invest in tools and trainings for external outreach, communicating results, collaboration best practices, and workforce development
Monitoring and social learning	Develop a culture of shared learning, monitoring, and adaptive management	21 (9%)	-Conduct implementation and effectiveness monitoring with collaborative partners to learn, make changes, and report lessons learned -Establish and provide resources for robust landscape-scale monitoring -Use best available science and information for sound forest management -Share lessons learned and best practices in peer-learning forums
Trust, relationships, and commitment	Maintain or increase collaborative trust, working relationships, and broad commitment to collaboration	17 (8%)	-Develop new and re-establish existing relationships and trust with partners -Establish broad commitment and support (i.e., direction and resources) for collaborative process from Forest Service leadership and staff, collaborative members, and partners -Make collaborative engagement part of annual performance reviews for Forest Service personnel -Regional direction and incentives to commit to collaboration
External communication and outreach	Outreach to broader public for community buy-in,	11 (5%)	-Periodic sub-group meeting with collaborative and public to support consistent communication and understanding -Outward facing report tools

	communication, and education of ongoing work		-Education and outdoor experiences for public -Support local champions to communicate project purpose, need, and accomplishments -Communication plans and planning for communities
Local autonomy in decision making	Reduce barriers to implementation through local autonomy in decision making	3 (1%)	- Devolve operational decision-making to local units -Transfer prescribed fire decisions to land and resource management staff

3.4.1 Inclusive engagement throughout process

Respondents recommended the inclusion of diverse entities and interests in the collaborative process. Respondents reported an unbalanced representation of the full spectrum of interested and affected parties. Particularly, some respondents suggested representation was skewed towards timber-focused entities and interests. Respondents wanted to see more representation from tribes, land grants, other traditional forestry and ranching communities, local communities and governments, private landowners, recreation groups, conservation and environmental organizations, non-governmental organizations, and/or local and regional businesses. Respondents noted the importance of engaging with and including tribes and lands grants in meaningful and culturally appropriate ways, for example by requesting time on Tribal Council or General Council meeting agendas rather than an invitation to collaborative meetings or field trips.

Relatedly, respondents recognized the need to open the collaborative space to different interests that encapsulate the multi-use mission of the Forest Service, including fish and wildlife, recreation and tourism values, broader ecosystem services, biomass utilization, grazing issues and impacts, cultural heritage, and prescribed fire. As one respondent mentioned,

> *there needs to be a deliberate intent to understand challenges outside of commercial timber removal from the forest to shift some of the support to other resources, cultural and natural, to address other challenges (wildlife, range, heritage, prescribed fire, etc.) of getting our restoration objectives meet [sic] while enhancing the multiple values we are tasked with managing across the forest. Restoration, while important, is not just commercial removal of timber.*

Respondents also recommended additional venues for open dialogue and negotiation from direction-setting to implementation to daylight different viewpoints and interests, work towards shared understanding of the problems they faced, and strategies to solve problems across the landscape. A key recommendation was to increase the number of in-person meetings, field trips, and retreats, particularly among projects who witnessed declines during the COVID-19 pandemic. Respondents were interested in neutral spaces that allowed for addressing disputed or controversial issues, which respondents felt was a key benefit of collaboration. Respondents recommended more "co-working" activities, where collaborative members were more involved in the decision-making process. Particularly, participants wanted to be more aware of funding timelines, have ample notice of funding opportunities, and understand funding allocations. They also wanted more engagement and understanding about the decisions the Forest Service made, and how the Forest Service considered collaborative input, saying:

> *we need more opportunity for open discussion with honest dialogue and clear answers. We need to be able to have clear answers from Forest Service about decisions and know that they are taking into account opinions of stakeholders. Meetings tend to be presentations of work with little discussion of direction or other options.*

Respondents were interested in working together to identify future goals, gain alignment among members about the need for increasing restoration pace and scale, develop desired conditions and zones of agreement, and collectively determine the goals and rationale for proposed projects. One respondent in particular noted the need for additional engagement to support collaborative planning and analysis pursuant to the National Environmental Policy Act (NEPA),

> *there needs to be an easy way for collaborative partners to more legally be more active in the NEPA process after initial scoping, but before publication of the DEIS [Draft Environmental Impact Statements]…Our collaborative partners bring a lot of refereed science to the table and not having them transparently there was not efficient for the FS [Forest Service] nor for the collaborative partners. The [National Forest] never intended to be a "black box" during this stage of the planning process.*

Several respondents recommended a framework and process for collaborative engagement in cross-boundary treatment assessment and prioritization, with shared priorities, clear plans for funding,

and sequencing to achieve landscape restoration goals. Respondents also recommended more engagement of collaborative members in the monitoring and adaptive management process, as indicated by a member of the research community here,

> *from the monitoring side, the main input I get is from the FS. I would love to invite other voices to speak to the monitoring process…Our only direct access with other voices in the collaborative is when we present data.*

3.4.2 Institutional arrangements

Respondents called for the development of collaborative protocols and processes that are transparent, responsive to input from the constellation of interested and affected entities, and hold partners accountable to collaboration. This included developing charters, memoranda of understanding (MOU), and other documents and procedures that outline roles, responsibilities, and expectations throughout the collaborative process. This theme was similar to, and in some cases overlapped with, the desire of collaborative members to be more involved and knowledgeable about decision-making throughout the collaborative process ("inclusive engagement throughout the process").

Respondents recommended clear guidelines for how the Forest Service selected projects based on collaborative input, in addition to how cross-boundary implementation will occur, information about annual schedules and project selections, and how and when collaborative members could engage in CFLRP implementation and outyear planning with the Forest Service. Some respondents were concerned that project planning processes were becoming overly complicated and time-consuming. They recommended clearly defined and streamlined processes to: 1) implement projects in realistic timeframes; and 2) minimize meeting fatigue and declining participation.

Respondents recommended mechanisms for accountability, both among collaborative members and between the collaborative members and the Forest Service. For example, respondents noted the need for established and agreed upon procedures to address disruptive members. In this vein, respondents recommended considering modified consensus for decisions, or other mechanisms to

acknowledge minority opinions, while still making progress on actions that the majority of members could agree upon.

Respondents noted the need to clearly document motivations, roles, expectations and capacities. Several CFLRP projects include multiple collaborative entities, span multiple forests, and/or are situated within multiple large-scale forest restoration initiatives (e.g., Shared Stewardship, Joint Chiefs, Wildfire Crisis Strategy). Respondents suggested more clarity on expectations for how to engage across these overlapping, and somewhat redundant, systems. For example, one participant recommended more clarity on how existing place-based collaborative groups would inform the broader CFLRP project and limit redundancies,

> *a clearer understanding of how the [CFLRP project] governance structure and processes compliment and support existing place-based collaborative structures is also important - the goal wasn't to form a new collaborative that spanned all of the place-based groups on the [National Forest], but rather to network and leverage the work they are doing successfully to plan, implement, and monitoring [sic] work at the landscape-scale. Making the connection between place-based groups and the [CFLRP project] more clear and not a huge lift for participants could use improvement.*

Relatedly, a respondent from a project that overlapped with a recently awarded Wildfire Crisis Strategy landscape wanted clear definitions on the scope of the CFLRP project and expectations for participation as they perceived a shift in focus from CFLRP activities to the Wildfire Crisis Strategy. Another highlighted the need to document differential capacities among groups and their relative power to influence decisions and move work forward,

> *it should be more important to recognize the different roles that CFLRP members/representatives have with their organization as well as the power dynamics between smaller, community-led groups and industrial and government partners. A mill or state agency will have a well-paid specialist devoted to CFLRP work, with CFLRP training, facilitation, and coordination training. Smaller organizations may be devoting their executive director to the effort, and they will only have so much time/attention to devote to issues compared to an outfit that can hire a specialist for the work. The specialist can therefoer bring more to the table and lead a lot of work instead of the smaller organizations that have a more intimate relationship with the communities and landscapes in the CFLRP footprint.*

Several respondents recommended collaborative protocols and processes be periodically revisited and refined by new and existing members to maintain institutional memory of the collaborative objectives, processes, and actions,

> *make sure people think about and actually use the collaborative protocols. They're kinda [sic] background - people signed them ages ago, but I bet not very many people have read them recently. They're supposed to be creating a different kind of space; one in which people can feel safer to speak their piece. But if we don't think about that very often, it doesn't work and people just go back to their normal street habits.*

Turnover in agency personnel and collaborative members is inevitable. Thus, respondents suggested developing onboarding documents and periodically revisiting their "why" in onboarding workshops and/or at collaborative meetings was a critical need.

3.4.3 Resources and capacity

Respondents recommended additional capacity in agency personnel, collaborative members, technical expertise, boundary spanning organizations and individuals, workforce, and third-party facilitation. Turnover was a common disruption across most projects that undermined trust, institutional knowledge, and commitment to shared objectives. More continuity and redundancy in Forest Service staff and additional capacity to engage in the collaborative process, particularly among district level staff, was suggested,

> *greater capacity within the Forest Service districts. Regardless of agreement between stakeholders, projects are dependent on the planning. The [National Forest] currently has two fish biologists, two botanists, two archaeologists, two hydrologists and two wildlife biologists to plan projects on a forest of over 3 million acres. Planned projects needs to be thorough and mindful in order to maintain any trust the Forest Service has earned and that takes time. Greater capacity within the districts will result in larger, solid projects sooner. Less capacity, with the expectation of increased pace and scale, results in poorly designed projects and an erosion of trust among the stakeholders.*

Others noted the importance of bringing on the requisite technical experts and funding to support landscape prioritization, monitoring, and adaptive management. In this vein, several respondents noted the importance of, and need to continue to fund, boundary-spanning individuals and

entities (e.g., National Forest Foundation, Forest Stewards Guild) to support coordination, implementation, and monitoring. A key area of need for several projects was third-party facilitation to set agendas, ensure collaborative members were aware of, and adhered to, collaborative protocols, and to manage communication and negotiation between all interested and affected entities,

> *there are many areas for improvement in our collaborative. The main solution being to hire a third-party facilitator to organize collaborative meetings full-time so that we can engage equitably and efficiently. There needs to be more organization and clarity around objectives and expectations. We need transparent protocols and procedures. Frankly stakeholder engagement is an onerous and crucial task to which we should be diligently assigning the most appropriate professional to achieve and unfortunately this is not the case.*

The amount, timing, and restrictions on the use of funding was also a key disruption to collaborative progress and performance. Respondents recommended supplemental funding for collaborative planning, monitoring and adaptive management, and implementation. In particular, some respondents emphasized the importance of funding for collaborative engagement, most of which is not supported by CFLRP funds,

> *we need to invest in collaborative capacity to plan, monitor, conduct outreach, and participate in the process of collaborating. It doesn't happen for free and time itself is a major barrier to entry.*

Respondents also recommended funding for collaborative members to travel and participate in collaborative activities. Finally, respondents recommended projects invest in tools and training on best practices for collaborating with each other and with the Forest Service, as well as workforce development training and collective reporting tools.

3.4.4 Monitoring and social learning

Respondents recommended additional support for, and improvements to, implementation and effectiveness monitoring, as well as collaborative adaptive management. Respondents noted the importance of improving effectiveness monitoring at multiple scales, and wanted to see a clear path and process for collaborative members to engage in the adaptive management cycle,

> *It seems that there is a view the FS [Forest Service] is the only entity that should engage on CFLRP shared learning, monitoring, and reporting (it is considered more of an internal agency program separate from the collaborative). This is a problem.*

Improved communication about data collection and sharing within the collaborative and with the Forest Service, better monitoring data and reporting mechanisms, and increased engagement in adaptive management reportedly could foster shared learning and help highlight successes and project take-aways internally and externally. Specifically, respondents recommended the need for collective reporting dashboards and more frequent sharing of results with partners. One respondent noted the importance of collaborative field trips as a way to learn about and inform adjustments to implementation,

> *I would like to see more restoration project visits included with the timber sale area visits. I would like to see [the collaborative] go through a Decision from a collaborated project and line by line go through and ask each other 'did we do what we said we were going to do'.*

In this sense, having clear protocols that outline expectations for how collaborative input and monitoring will inform subsequent changes to management actions was important. Some respondents from extension projects noted a long history of co-developed science and information, and they recommended the project revisit that information and use it to inform forest management. More broadly, respondents recommended their project invest in joint learning and peer learning activities to share project successes as learning opportunities for collaborative cross-boundary forest restoration and resilience work in other contexts.

3.4.5 Trust, relationships, and commitment

Recommendations included maintaining or enhancing a broad commitment to collaboration and building trust and strong working relationships to accomplish collaborative work. Respondents' recommendations to build trust and working relationships were correlated to recommendations for opportunities for engagement throughout the process ("inclusive engagement throughout the process"). Broader commitment among collaborative members and the Forest Service across levels of authority

(e.g., line officers, resource specialists) was recommended. One respondent recommended collaborative engagement should be part of Forest Service annual performance reviews,

> *create a mechanism whereby Forest Service Line Officers (District Rangers and Forest Supervisors) are heavily weighted on engaging in collaborative efforts when performance reviews are conducted. This is especially critical when collaboration across forest boundaries to achieve desired objectives is a key component.*

Additionally, several projects span multiple Forests. Respondents remarked that commitment to the collaborative process was highly variable across Forest units, and recommended top-down pressure to encourage Forest staffs' commitment to the collaborative process.

3.4.6 External communication and outreach

Respondents recommended enhanced external communication using a variety of communication tools and approaches for diverse audiences. Respondents suggested periodic meetings with key partners inside and outside the CFLRP landscape to increase public understanding of the purpose and need of the project and outward facing reporting tools to demonstrate accomplishments. Respondents also recommended increasing opportunities for K-12 and adult education and outdoor learning experiences. Local champions were recommended to help share and translate information to local communities. There was also a reported need for communication plans or engagement strategies for working with partners, especially underserved communities, even if they choose not to participate.

3.4.7 Local autonomy in decision making

Three respondents recommended "local autonomy in decision making" to improve collaborative progress. Although relatively few respondents recommended these changes, the recommendations spanned three regions and were all related to national-level barriers to prescribed fire and mechanical treatment implementation. The Hermit's Peak/Calf Canyon wildfire, which started from two escaped prescribed fires, and the subsequent pause on prescribed burning nationwide, caused ripple effects in implementation locally and regionally, as indicated by one respondent in the Eastern U.S.,

> *a prime example is the recent national pause in prescribed burning due to an escaped prescribed burn in New Mexico. Our [CFLRP project] suffered the loss of many suitable burning days. This materially diminished the number of acres that could have and should have been burned in our project area. This project alone requires approximately 100,000 acres of prescribed burning annually and there are rarely enough days with good burning weather in any given year to accomplish this work.*

To address this challenge, respondents recommended the need to devolve decisions to operate to local units, and one respondent recommended prescribed fire decisions should be made by land and resource managers and not the fire staff.

3.5 Discussion

We evaluated CFLRP participants' recommended actions and adaptations to improve collaborative processes and maintain progress towards desired outcomes, which we summarized into the following seven themes:

- Maintain a forum for inclusive communication and dialogue throughout to develop shared understanding, priorities, and actions;
- Enact and periodically revisit clear, responsive, and accountable collaborative structures and processes;
- Maintain and enhance human and financial resources and capacity;
- Develop a culture of shared learning, monitoring, and adaptive management;
- Maintain or increase collaborative trust, working relationships, and broad commitment to collaboration;
- Outreach to the broader public for community buy-in, communication, and education of ongoing work; and
- Reduce barriers to implementation through local autonomy in decision making (Table 3.2).

We discuss these findings in light of collaborative governance theory and practice, and we introduce relevant resources and actions that practitioners and funders of collaboratives may deploy to support collaboratives in working towards forest and fire management objectives.

A large proportion of respondents recommended more diverse and inclusive representation. Broad inclusion can facilitate knowledge and resource sharing and social learning, promote internal and external legitimacy, relevance, and credibility, support broad ownership and support of management actions, and reduce the potential for future conflict (Ansell et al., 2020; Karambelkar and Gerlak, 2020; Provan and Milward, 2001). However, broad inclusion can also result in higher transaction costs, lead to outcomes that are agreeable but retain the status quo, or do not address more controversial actions. Deliberation times may increase as the potential for disagreement among parties increases, which in turn, can strain already scarce resources (Ansell et al., 2020; Wondolleck and Yaffee, 2000). Also, many factors affect whether individuals or entities choose to participate, including the time or energy required to engage, perceived mutual interdependence, resource availability, and variable incentives (Ansell et al., 2020; Purdy, 2012). For example, Tribes have alternative venues in which to address their interests and objectives in public lands management, and thus may not choose to engage on those grounds. The history of injustices and violations of tribal rights and sovereignty may also contribute to how Tribes choose to engage, or not. Inclusion may be approached through thoughtful, active management and selective activation, which refers to including participants who can commit to the process and/or are needed to address a specific issue or purpose (Ansell et al., 2020).

Respondents also recommended more principled collaborative engagement throughout the restoration process. An oft-cited barrier to collaboration in public lands management is that regulations, mandates, and decision space are not well articulated or understood among collaborative participants, which, in turn, makes efficient and meaningful collaboration challenging (Cheng and Sturtevant, 2012; DiBari and Randall, 2018; Monroe and Butler, 2016). Thus, early and frequent collaboration throughout

the process is critical to articulate decision space (i.e., the range of options that are available to decision-makers and feasible to implement) and decision authority, help participants understand how and when to inform decisions, and articulate what decisions are made and why (DiBari and Randall, 2018). For example, respondents sought opportunities to engage in collaborative, cross-boundary treatment planning and prioritization. Spatial wildfire decision support tools and platforms, including quantitative wildfire risk assessments, Potential Operational Delineations (PODs), and scenario investment planning can be used to facilitate collaborative, cross-boundary planning (Dunn and Wolk, 2023; Huayhuaca et al., 2023; Scott et al., 2013). In the context of multi-party monitoring and collaborative adaptive management, annual monitoring workshops, field trips, and qualitative field reviews of implementation actions are important to collectively evaluate how management actions are implemented and whether outcomes met desired objectives (Beeton et al., 2022; Butler et al., 2019). Clear "plug-in points" or feedback loops can clarify how stakeholder input informs subsequent prescriptions, project planning and treatment location, and modifications, if warranted, to collaborative goals, desired conditions, and/or the monitoring protocol (Cheng et al., 2019). Participating throughout the process helps build trust, relationships, and shared understanding, which, in turn, establishes norms and assumptions for collaborative engagement and supports informal accountability (Butler et al., 2015; Christenson and Butler, 2019; Lee, 2022).

Other resources may be useful for increasing understanding of, and collaborative engagement in, planning, implementation, monitoring, and adaptive management on public lands. For example: the National Forest Foundation (NFF) developed a guide for collaboration before, during, and after NEPA (Schmidt, 2013); Brown (2015) described the Forest Service administrative and judicial review process and identified insertion points for collaborative members to engage in the process; and the Rural Voices for Conservation Coalition (RVCC) developed a step-by-step guide of the Forest Service planning and implementation process (Cowan, 2022). The NFF also maintains an resource repository for effective

collaboration[22], as does the Center for Collaborative Conservation[23], including a toolkit for meaningful engagement with Indigenous Peoples (Center for Collaborative Conservation, 2023). National and regional peer-learning and landscape-scale cross-boundary collaborative restoration communities of practice like those managed by the NFF, RVCC, Western Collaborative Conservation Network, and Sustainable Northwest are key venues to share lessons learned and innovations in practice.

Respondents were interested in co-developing the requisite structures and processes that codified the rules and expectations for engagement, conflict resolution, and decision-making throughout the process. Research and practice emphasize the importance of collaboratively developed chartering documents (e.g., charters, memoranda of understanding) that outline roles and responsibilities and the sequence of activities for collaborative members to engage, in addition to shared restoration strategies, implementation guidelines, and/or prescription design criteria developed through joint fact-finding (Antuma et al., 2014; Beeton et al., 2022; Cheng et al., 2015). For example, some respondents recommended structures and processes for negotiating controversial issues and dealing with disruptive members. Groups have addressed conflict and controversy through documenting undesired conditions rather than desired conditions, documenting "issue-based" recommendations or both majority and minority opinions as recommendations for action to the Forest Service, and through interest-based negotiation often supported with third-party facilitation (Christenson and Butler, 2019; Coleman et al., 2018; Urgenson et al., 2017). Collaborative protocols and documents can help institutionalize joint knowledge and learning and establish formal accountability mechanisms (Christenson and Butler, 2019; Lee, 2022). When possible, collaboratively developed documents should be included in agency decision documents and procedures (e.g., NEPA Record of Decision or Environmental Assessment) (Cheng et al., 2019).

[22] https://www.nationalforests.org/collaboration-resources/tools-search
[23] https://collaborativeconservation.org/resources/how-to/

Participants indicated the need for more commitment from Forest Service partners and other participating organizations. Many collaborative governance arrangements are embedded within complex, networked governance settings, which may create competing demands for people's energy and time (Margerum and Robinson, 2015). Thus, participating individuals and entities must make tactical and strategic decisions about their level of commitment to overlapping and perhaps conflicting processes (Lee, 2022; Margerum and Robinson, 2015; Romzek et al., 2014; Waardenburg et al., 2020). Collaborative participants have different accountabilities and commitments to the collaborative, their funders, and their parent organizations. When accountabilities conflict, participants will often prioritize commitments to their parent organization at the expense of the collaborative (Lee, 2022). In the Forest Service, local administrative units are given considerable autonomy in decision making (Moseley and Charnley, 2014). The decision to commit to collaboration often comes down to leadership support and direction for collaboration, and the interpretation of how agency rules, regulations, mandates, and performance targets align or conflict with collaborative goals. Collaboration is often not a part of agency staff job requirements, which together creates little incentives to commit to the process (DiBari and Randall, 2018; Moote and Becker, 2003). As a result, our results and others demonstrated variation in commitment to collaboration across CFLRP projects and even across districts or Forests within CFLRP projects (Bergemann et al., 2019).

Variable commitment to the process, whether as a function of conflicting accountabilities or resource availability (e.g., paid vs. volunteer contributors), can diminish trust and working relationships as partners are unable to participate in ways that meet others' expectations. Unclear or undocumented institutional arrangements can lead to different expectations of roles and commitments to the process. Clarifying and aligning expectations (see Forest Service, 2021), documenting roles and commitments (Cowan and Davis, 2022) to the collaborative, parent organizations, and other related regional efforts, and collaboration training for collaborative partners and agency staff (DiBari and Randall, 2018) can help

temper conflict, put realistic sideboards on collaborative engagement, and identify synergy between seemingly contradictory accountabilities (Lee, 2022; Ospina and Saz-Carranza, 2010). This is especially important given the overlap and potential competition in demands for time and energy from the CFLRP, existing place-based and all-lands collaboratives, and other Forest Service-administered programs that often overlap with CFLRP funded projects, including the Joint Chiefs' Landscape Restoration Project, Shared Stewardship, and the Wildfire Crisis Strategy.

The collaborative process and progress was challenged by frequent turnover, the agency culture of "acting" positions, and inability to fill vacancies, especially among resources specialists and other staff critical to accomplishing work on the ground. Leveraging regional and national planning teams and independent contractors may help fill capacity gaps in personnel, advancement-in-place opportunities may help reduce turnover, and including collaboration with partners in Forest Service job requirements and evaluations or hiring partnership liaisons could increase agency capacity and incentives to engage (Beeton et al., 2022; Butler and Schultz, 2019; DiBari and Randall, 2018). While turnover is inevitable in any long-term collaborative restoration effort, it is especially challenging when turnover occurs in the Forest Service. In the context of the CFLRP, the Forest Service is a necessary partner, but their evaluation and incentive structure doesn't typically require collaboration as a primary job duty.

Groups must develop a transition strategy to absorb turnover and maintain institutional knowledge, which could be achieved through redundant roles, mentoring systems, ensuring overlap between incoming and outgoing staff, onboarding workshops and materials, and/or participating in the Forest Service hiring process (Antuma et al., 2014; Cheng et al., 2019; Coleman et al., 2020; DiBari and Randall, 2018). Further, commitments and capacities are continuously negotiated as people come and go, thus periodically revisiting institutional arrangements with new and existing members is warranted (Beeton et al., 2022; Cheng et al., 2015; Orth and Cheng, 2019).

Lastly, constraints on the timing, amount, and use of funds affected the ability of collaboratives to engage and accomplish work. The CFLRP requires collaborative involvement throughout planning, implementation, and monitoring. However, funding is only authorized to pay for up to 50% of implementation and monitoring costs and can only be spent on Forest Service-managed land (Schultz et al., 2012). Funds cannot be used for collaborative planning, social learning, and technical and support staff to coordinate efforts, nor can funds be used to pay Forest Service salary. Thus, supplemental funding to support local champions, third-party facilitation, and technical experts is needed. These boundary spanners can help transfer knowledge and information to community-connected partners, bolster shared agreement, develop institutional arrangements and hold collaborative participants accountable to them, and deploy the best available science and information for collaborative treatment prioritization, monitoring, and adaptive management (Beeton et al., 2022; Cheng and Sturtevant, 2012; Colavito, 2019; DiBari and Randall, 2018). Leveraging federal programs that fund collaborative capacity building, including the National Forest Foundation Collaborative Capacity Program for Forests & Communities and USDA Forest Service Community Navigators Program, may provide a starting point to address this policy shortcoming.

3.6 Conclusion

In conclusion, we developed and deployed a program-wide collaborative governance assessment to new and reauthorized projects funded under the Collaborative Forest Landscape Restoration Program (CFLRP) and administered by the USDA Forest Service in the United States. We documented respondents' recommended actions and adaptations to improve collaborative processes and progress. Findings reveal six key points. First, while groups often seek to be more inclusive, there are many factors that influence inclusion, and there is an inherent tradeoff between broad inclusion and efficiency. Inclusion is an active process and collaborative groups should invest time and resources to inclusion management and selective activation based on current and expected needs and objectives. Second, there is a need for

developing transparent, fair, and responsive structures and processes for engagement throughout the collaborative process. Taking time to build trust, relationships, and shared understanding by engaging with collaborative members from direction setting to implementation helps develop informal accountability, while co-developing and -enforcing collaborative documents facilitates formal accountability mechanisms between collaborative members and the Forest Service.

Third, variable and ambiguous commitments, motivations, and expectations create accountability tensions, and these change through time as people come and go, or as priorities change. Periodically revisiting and reshaping collaborative processes, protocols, and documents that dictate social-interactional activities is critical. Fourth, developing a culture of collaboration in the Forest Service, where agency staff have the capacity, direction, and incentives to commit to the collaborative process, may help sustain productive forest and fire management across boundaries and over time. Fifth, our results indicate a need for supplemental funding streams to support the collaborative capacity building. Sixth, a key purpose of this work was to identify collaborative actions and adaptations that are needed to improve collaborative processes and progress. Emerson et al. (2012) suggest adaptations should be relatively easier to implement in collaborative governance regimes because they are in theory more flexible and horizontally structured. Yet, collaboration in the CFLRP is nested within an existing hierarchical, bureaucratic organization in the Forest Service, which holds decision authority over management actions. Adaptations must fit within existing rules, regulations, and mandates, and research has indicated the latitude for adaptability may be constrained in these contexts (Abrams et al., 2017; Beeton et al., 2022; Cheng et al., 2015; Schultz et al., 2021). Thus, which of these recommendations are actionable remains an open question and are likely to be context-specific.

Several of the challenges participants were dealing with at the time of the assessment have been highlighted as collaboration challenges since the early 2000s (Margerum, 2007; Margerum and

Robinson, 2016; Wondolleck and Yaffee, 2000), and specifically noted in Forest Service-administered programs including Joint Chiefs' (Cyphers and Schultz, 2019), Shared Stewardship (Aldworth and Schultz, 2023; Kooistra et al., 2021), and CFLRP (Beeton et al., 2022; Butler and Schultz, 2019). These barriers to collaboration need to be addressed to support healthy, durable, and resilient collaboration. Further, many of the issues highlighted in this paper explicitly acknowledge the dynamic and evolving nature of collaboration. A limitation of the current study, and an oft-cited limitation of much work in the collaborative governance arena (Ulibarri et al., 2020), is that this was a point-in-time assessment. The results presented herein constituted a baseline survey that is grounded in the CFLRP Common Monitoring Strategy. Thus, this work lays the foundation for assessing collaboration dynamics, needs, and outcomes longitudinally. Future work should deploy longitudinal assessments of collaborative progress and performance in the CFLRP and other environmental governance contexts. A number of open questions remain which may provide fodder for future research. For example, how do projects navigate multiple, overlapping, and ever-changing policy directions and investments? How do the actions and adaptations needed fluctuate through time? To what extent is there flexibility in the system to adapt collaborative structures and processes? Which actions and adaptations are feasible and desirable given variable, conflicting, and changing motivations, expectations, commitments, and accountabilities? What actions and adaptations taken at one point in time cultivate or constrain progress and adaptability in the future? These are critical research avenues as long-term cross-boundary collaboration is increasingly invested in to meet forest and fire management goals.

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CHAPTER 4: DEVELOPING RELIABLE AND VALID MEASURES FOR EVALUATING COLLABORATIVE GOVERNANCE AND ADAPTABILITY: AN EXAMPLE FROM THE COLLABORATIVE FOREST LANDSCAPE RESTORATION PROGRAM[24]

4.1 Introduction

In recent decades, there has been an increased emphasis on, and application of, collaborative and adaptive forms of environmental governance as a means to manage conflict, reduce uncertainty, address complex social-ecological problems that cannot be achieved alone, and increase sustainable resource management (Emerson et al., 2012; Emerson and Gerlak, 2014; Folke et al., 2005; Gupta et al., 2010; Ulibarri, 2019; Wondolleck and Yaffee, 2000). Here, we refer to collaborative governance as "the processes and structures of public policy decision making and management that engage people across the boundaries of public agencies, levels of government, and/or the public, private for-profit, and civic spheres to carry out a public purpose that could not otherwise be accomplished" (Emerson et al., 2012, p. 2). We refer to adaptability, or adaptive capacity, as "the ability of the CGR [collaborative governance regime] to alter its internal processes or convert structural elements as a response to experienced or expected changes in the societal or natural environments" (Emerson and Gerlak, 2014, p. 770).

There are a number of claimed benefits of collaboration, including enhanced efficiency and effectiveness when compared to top-down or centralized governance approaches, increased trust and legitimacy, shared understanding and support for locally relevant decisions, and enhanced social learning, all of which have the potential for spillover effects to other venues (Agranoff, 2006; Emerson et al., 2012; Koontz and Thomas, 2006; Pahl-Wostl, 2009; Struthers et al., 2023; Wondolleck and Yaffee, 2000). As a result, federal land management agencies in the United States, like the U.S. Department of Agriculture Forest Service (Forest Service hereafter), have increasingly invested in collaboration to accomplish

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wildfire and forest management goals (Butler and Schultz, 2019; Cheng and Sturtevant, 2012). Notable examples include the Healthy Forests Restoration Act of 2003, the Forest Landscape Restoration Act of 2009 that authorized the Collaborative Forest Landscape Restoration Program (CFLRP), the Joint Chiefs' Landscape Restoration Partnership, and the Shared Stewardship Strategy (Aldworth and Schultz, 2023; Butler and Schultz, 2019; Kee et al., 2023; Kooistra et al., 2021; Schultz et al., 2018, 2012).

These programs have attracted the attention of social and ecological science, and increasing evidence suggests that these programs have promoted positive social, economic, and ecological outcomes (e.g., Barrett et al., 2021; Butler and Schultz, 2019; McIver and Becker, 2021). Still, a number of research gaps remain, which, if addressed, could support the above-mentioned programs and other collaborative initiatives in evaluating progress and performance towards desired goals. The majority of research in the collaborative governance and adaptability arena has relied on individual or small-n case studies (Ansell and Gash, 2007; A. R. Siders, 2019; Ulibarri et al., 2020). Individual case studies are necessary as they provide local, nuanced information, which cannot be garnered by larger-n comparative assessments, and they are useful for theory-building (Conley and Moote, 2003; Douglas et al., 2020a; Emerson et al., 2012). Several case studies have developed measures of collaborative governance and adaptability for internal assessment purposes. While important for evaluating local efforts, this has led to a multitude of definitions, indicators, and proposed factors (i.e., latent, unobserved variables or constructs), which limits our ability to make inferences across cases and contexts (Conley and Moote, 2003; Emerson et al., 2012; Koontz et al., 2015; Siders, 2019). There is no consensus on the number and configuration of, and relationship between, factors that comprise collaborative governance and adaptability. Studies often employ these factors assuming they represent reliable, valid, and discrete constructs, but most research to date lacks formal tests of assumptions related to the dimensional structure and validity of factors thought to represent collaborative governance dynamics and adaptability (c.f., Lockwood et al., 2015). Therefore, there is a need for systematic and cross-case assessments situated within robust statistical frameworks to

further our understanding of the components and elements that cultivate collaborative governance and adaptability (Douglas et al., 2020a; Emerson et al., 2012; Koontz et al., 2020).

We developed and administered a standardized survey assessment, grounded in the theory and practice of collaborative governance and adaptability (Cinner and Barnes, 2019; Emerson et al., 2012; Emerson and Gerlak, 2014; Folke et al., 2005; Gupta et al., 2010), to the flagship CFLRP and its 15 authorized projects across the United States (Figure 4.1). We used confirmatory factor analysis (CFA) to test the structure set forth by Emerson et al. (2012) and expounded on by Emerson and Gerlak (2014). Our two objectives were to:

1. confirm the number and configuration of factors that comprise collaborative governance and adaptability; and
2. evaluate the reliability and validity of our collaborative governance and adaptability measures.

Our study offers a starting point to address key research gaps in the understanding of collaborative governance and adaptability, which ultimately could support collaborative initiatives in evaluating collaborative progress and performance relative to project and program goals.

4.1.1 A brief history of collaboration in the Forest Service

Beginning in the 1960s, national-level legislation emerged to protect natural resources and allow for more public engagement and transparency around public forest planning and actions, including the Wilderness Act of 1964, the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, and the National Forest Management Act of 1976. By the 1980s, some actors used this legislation as a mechanism to challenge forest management actions in courts, and by doing so, prompted a significant reduction in timber harvests on federally-managed lands and fundamental changes in land use in these systems (Beier et al., 2009; Sousa and Klyza, 2007; Trosper, 2003).

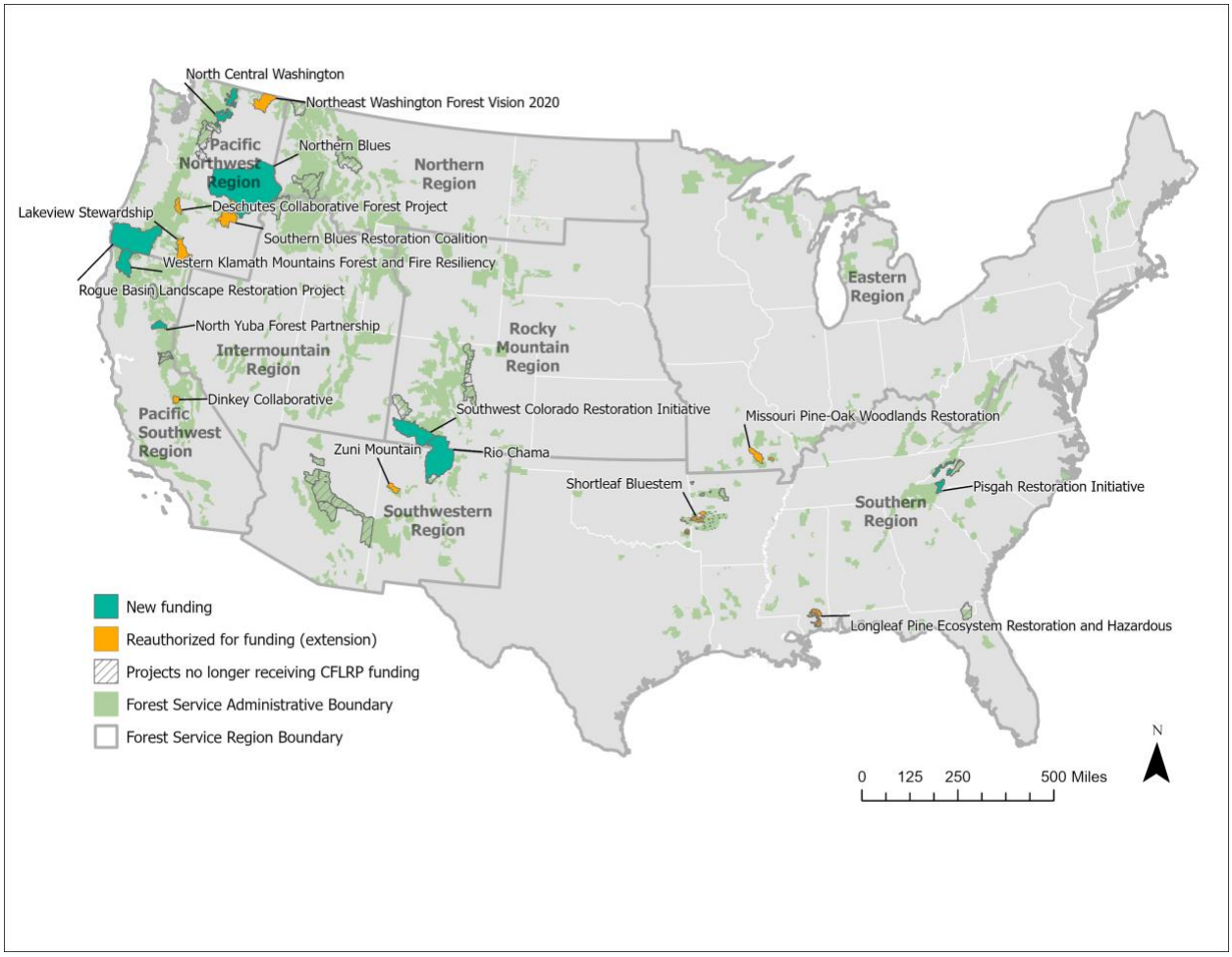

Figure 4.1: Map of CFLRP projects. Newly authorized and extension projects are depicted in green and orange, respectively. These projects are the focus on this study. Projects no longer receiving funding (hatched) first received funding in 2010-2013 for 10 years.

By the 1990s, a shift to collaborative governance approaches in public land management agencies, like the Forest Service, emerged in direct response to this litigation and other legal, regulatory, and bureaucratic challenges (Cheng and Sturtevant, 2012; Koontz et al., 2020; Schultz et al., 2021; Wondolleck and Yaffee, 2000). Abrams (2019) traced this transition towards collaborative governance and related it to three key factors: 1) the decline in the Forest Service's organizational legitimacy, autonomy, and discretion; 2) the decline in agency capacity as a function of lost political support among powerful timber interests, ballooning fire suppression budgets without concomitant increases for other activities, and loss of timber revenue due to the restructuring and downsizing of the timber industry; and 3) the need for innovation. This

period of time was characterized by the ecosystem-based management revolution, where there was increasing emphasis on management for linked ecological, economic, and social sustainability goals (Abrams, 2019; Abrams et al., 2017; Cheng and Sturtevant, 2012; Wondolleck and Yaffee, 2000).

The emergence of collaborative governance regimes in U.S. federal forest management was the result of both ground-up, grassroots movements and top-down policy direction. Grassroots, community-led collaboration occurred as a last result to address social, economic, and ecological issues that were important to communities but could not be addressed by the Forest Service. Local communities recognized they needed to work together to achieve shared goals or minimize common risks, such as wildfire (Cheng and Sturtevant, 2012; Nie and Metcalf, 2016; Wondolleck and Yaffee, 2000). Top-down processes spurred collaboration during this time as well. In 1998, Congress required service contracts administered by the Forest Service use a multi-party monitoring and evaluation process (Nie and Metcalf, 2016). Further, following the heels of the disastrous 2000 wildfire season, the National Fire Plan reshaped fire policy in the U.S., with the recognition that government agencies, non-government organizations, and local communities needed to work together to address the wildfire problem and mitigate social and ecological risks to wildfire (Fleeger, 2008).

4.1.2 The emergence and status of the CFLRP and multi-party monitoring

The Omnibus Public Land Management Act of 2009 included the Forest Landscape Restoration Act (FLRA), which authorized the CFLRP, the purpose of which was to "encourage the collaborative, science-based ecosystem restoration of priority landscapes" (PL111-11, Section 4001). The FLRA authorized the CFLRP until 2019, and between 2010 and 2019 23 projects were funded under the CFLRP (Figure 4.1). Congress reauthorized the CFLRP under the Agricultural Improvement Act of 2018. Funding for the CFLRP was also authorized in the 2021 Infrastructure Investment and Jobs Act (IIJA). In 2020, the Forest Service issued a request for proposals for funding new and existing projects for up to 10 years. Seventeen CFLRP projects currently receive funding, including eight new and nine extension

(projects previously authorized for funding) projects (Figure 4.1, Table 4.1). The focus of this paper is on 15 newly funded and extension projects that were authorized since 2020 (Table 4.1; the Longleaf Pine and Pisgah CFLRP projects were awarded funding after we had completed survey recruitment and administration).

Table 4.1: Project characteristics and response rate.

Project Name	New or reauthorized	State(s)	Forest Service Region(s)	N	Response Rate
Deschutes Collaborative Forest Project	Reauthorized	Oregon	6	34	40%
Dinkey Collaborative	Reauthorized	California	5	22	14%
Lakeview Stewardship	Reauthorized	Oregon	6	15	25%
Longleaf Pine Ecosystem Restoration and Hazardous Fuels Reduction	Reauthorized	Mississippi	8	-	-
Missouri Pine Oak Woodlands Restoration	Reauthorized	Missouri	9	15	41%
North Central Washington	New	Washington	6	20	38%
North Yuba Forest Partnership	New	California	5	23	40%
Northeast Washington Forest Vision 2020	Reauthorized	Washington	6	9	15%
Northern Blues	New	Oregon; Washington	6	33	32%
Pisgah Restoration Initiative	New	Tennessee	8	-	-
Rio Chama	New	Colorado; New Mexico	2, 3	38	19%
Rogue Basin Landscape Restoration Project	New	Oregon; California	6	18	32%
Shortleaf Bluestem	Reauthorized	Arkansas; Oklahoma	8	25	26%

Southern Blues Restoration Coalition	Reauthorized	Oregon	6	21	13%
Southwest Colorado Restoration Initiative	New	Colorado	2	28	26%
Western Klamath Mountains Forest and Fire Resiliency	New	California	5	25	24%
Zuni Mountains	Reauthorized	New Mexico	3	15	17%

The CFLRP was a unique policy instrument within the United States for several reasons. It established a competitive selection process, provided a flexible 10-year funding commitment, focused investments in priority landscapes on Forest Service-managed lands, and required projects to develop a multi-party monitoring plan and establish funding for monitoring for 15 years (Schultz et al., 2018). The FLRA also required collaboration during planning, implementation, and monitoring phases. However, collaboration was not defined, and the FLRA or CFLRP did not provide prescriptive guidelines for collaborative engagement and participation. This ambiguity provided flexibility for projects to establish collaborative structures and processes that fit local social, historical, and political contexts (Schultz et al., 2019).

Research suggests that the CFLRP has led to positive social and ecological outcomes, including restoration outcomes that align with desired conditions and objectives; increased landscape- scale and cross-jurisdictional planning; more efficient planning and diverse accomplishments; increased trust, relationships, and legitimacy; and minimized conflict and litigation (Barrett et al., 2021; Butler and Schultz, 2019; Cannon et al., 2018; McIntyre and Schultz, 2020; McIver and Becker, 2021; Schultz et al., 2018). However, the CFLRP was not without challenges. Frequent turnover, varied commitment and capacity to engage in ways that met collaborative members' expectations, resource constraints, and a lack of clarity with regards to the allowable decision space and accountability in some cases led to diminished

trust and challenges in getting work done on the ground (Beeton et al., 2022; Butler, 2013; Butler and Schultz, 2019; Christenson and Butler, 2019; Coleman et al., 2020).

In the first round of authorization (2010-2019), projects were required to develop and implement multi-party monitoring plans, which must involve multiple partners in the monitoring process. Multi-party monitoring was, and continues to be, critical for supporting social learning and trust-building (Schultz et al., 2014). Yet, there were also challenges, including varied capacity and expertise to develop and implement monitoring, limited landscape-scale monitoring, and a lack of common monitoring protocols and metrics deployed across projects, all of which led to difficulty assessing restoration outcomes across the CFLRP (Esch and Waltz, 2019; Forest Service, 2022; Schultz et al., 2014). To address these challenges, the Forest Service Forest, Range Management, and Vegetation Ecology staff partnered with Forest Service regions, CFLRP projects, and subject-matter experts to co-produce a common monitoring strategy (Forest Service, 2022). The strategy includes a core set of thirteen social, economic, and ecological monitoring questions that largely mirror the desired outcomes set forth in the FLRA. All newly authorized or reauthorized projects are required to address these questions. The intention is to institutionalize a rigorous, standardized monitoring program to monitor outcomes at the landscape scale and program-wide.

The common monitoring strategy includes evaluation of collaborative governance, in recognition that the collaborative health and resilience of projects can affect the pace and scale of implementing restoration actions on the ground and desired social and ecological outcomes. Tied to this component, the Forest Service asked the authors to develop a CFLRP-wide longitudinal assessment of collaborative governance and adaptability. Specifically, partners identified the need to monitor collaborative health, function, resilience, and perceived social, economic, and ecological progress.

4.1.3 Literature review: Collaborative governance and adaptability

We situated our assessment within the collaborative governance and adaptability literature (Ansell and Gash, 2007; Emerson et al., 2012; Emerson and Gerlak, 2014; Folke et al., 2005; Gupta et al., 2010), relying largely on the integrative collaborative governance framework advanced by Emerson et al. (2012) and expanded on by Emerson and Gerlak (2014) in their assessment of adaptability in collaborative governance, to frame our survey instrument. Emerson et al.'s (2012) integrative framework for collaborative governance is a useful framework within which to situate our assessment for a number of reasons. First, it synthesizes current theory, prior research, and practice of collaborative governance from many fields (e.g., conflict management, public administration, environmental governance, planning) (Ansell and Gash, 2007; Bentrup, 2001; Daniels and Walker, 2001; Innes and Booher, 1999; Milward and Provan, 2006; O'Leary et al., 2006, and the special issue therein). Second, the framework: 1) acknowledges that change is a fundamental property of the system; 2) recognizes the iterative and adaptive nature of collaborative processes and outcomes; and 3) aligns the collaborative governance and adaptability literatures (Emerson and Gerlak, 2014). Third, the framework includes testable propositions related to the composition of, and causal linkages between, components, which have largely been untested in the literature.

As our assessment is concerned with the structure and function of collaborative governance and adaptability, we specifically focus on the three factors (referred to as components in Emerson et al. (2012)) of collaborative dynamics in the framework – principled engagement, shared motivation, and capacity for joint action – to orient this literature review. *Principled engagement* is grounded in the concepts of transparent, inclusive, and civil communication and negotiation, where "safe" or "neutral" venues are created for discussing controversial issues. Principled engagement is comprised of an iterative process of discovery, definition, deliberation, and determination, where partners identify shared values and concerns and jointly agree on the problems, strategies to address problems, and the collective purpose (Emerson et al., 2012). Engaging the "right" people, i.e., interested and affected parties, is a critical consideration for principled engagement.

Shared motivation includes the concepts trust-building, mutual understanding, legitimacy, and commitment. It is also referred to as social capital in the adaptability literature (Folke et al., 2005; Pelling and High, 2005). Social capital is often considered the "glue" for adaptive capacity and collaboration (Folke et al., 2005, p. 451), and trust, in particular, is considered "the grease that allows the gears of collaboration to turn" (Ansell et al., 2020, p. 572). Social capital is facilitated by repeated interactions and investments in relationship- and legitimacy-building, and is often strengthened by mutual commitment (Emerson et al., 2012; Folke et al., 2005; Pelling and High, 2005).

Capacity for joint action includes concepts related to collaborative capacity and adaptive capacity in the collaborative governance and adaptability arenas, respectively (Emerson and Gerlak, 2014). Capacity for joint action includes the following sub-components: knowledge and learning; leadership; resources; and institutional arrangements. In a collaborative setting, knowledge and information should be co-created and shared equally among all members of the group, and information should be used to inform adaptive management processes (Emerson et al., 2012; Emerson and Gerlak, 2014). Adaptive governance emphasizes the role of social learning and flexibility, through which participants test, monitor, evaluate, and reflect on ecological trends (e.g., cause and effect of ecological disturbance), management action impacts, and broader assumptions related to problem framing, goals, values, and norms (Baird et al., 2014; Folke et al., 2005; Lebel et al., 2010; Pahl-Wostl, 2009; Sharma-Wallace et al., 2018). Flexibility in this context refers to the ability of groups to absorb social learning, improvise, and try out alternative actions in the face of uncertainty and change (Cinner et al., 2018; Gupta et al., 2010). Leaders can be convenors, facilitators, and/or sponsors, among others, and their roles may shift over time (Emerson and Nabatchi, 2015). Leaders are critical for linking people and entities to develop and accomplish shared goals, manage conflict, build trust, help steer collaborative direction, and maintain a collaborative vision and transparency (Ansell and Gash, 2007; Emerson et al., 2012; Flye et al., 2023; Folke et al., 2005; Olsson et al., 2006). Effective collaboration relies on sharing resources and the flexibility to mobilize

them when needed, including funding, personnel, technical support, and facilitation (Cinner and Barnes, 2019; Emerson and Gerlak, 2014; Gupta et al., 2010). Institutional, or structural, arrangements are the processes and protocols (e.g., charters, decision rules) that guide collaborative engagement, participation, and decision-making. Institutional arrangements should be codified within and across organizations (e.g., within collaboratives and between collaboratives and agencies) (Emerson et al., 2012) and should be fair and equitable, transparent, responsive, and accountable (Emerson and Gerlak, 2014; Gupta et al., 2010; Lockwood, 2010).

The integrative framework of collaborative governance proposed by Emerson et al. (2012) and expanded on by Emerson and Gerlak (2014) offers a useful heuristic to categorize collaborative governance dynamics and adaptability and provide a foundation for testing theory. However, despite over two decades of research on these topics, relatively little is known about how the factors influencing collaborative governance and adaptability interact and reinforce each other (Ulibarri et al. 2020). Thus, a necessary direction for guiding future applications of the framework is to empirically test its dimensional structure in terms of the factors that comprise collaborative governance and adaptability.

There are three gaps related to this point. First, there is no clear consensus on the number and configuration of factors that comprise collaborative governance and adaptability. For example, there is little understanding of whether the factors associated with collaborative governance and adaptability comprise distinct constructs (e.g., shared motivation), or represent dimensions of an underlying multi-dimensional construct (e.g., collaborative dynamics) (Emerson et al. 2012). Here, we use the term construct to refer to "the abstract idea, underlying theme, or subject matter that one wishes to measure" (Dew, 2008). Further, in the collaborative governance literature, Ansell and Gash (2007) postulate that institutional design (i.e., institutional arrangements), facilitative leadership, and informational work (i.e., knowledge and learning) are separate factors, whereas Emerson et al. (2012) consider them dimensions of capacity for joint action. Work in the adaptive capacity literature considers knowledge and learning,

resources, leadership, and institutional arrangements separate but related factors (Cinner and Barnes, 2019; Engle and Lemos, 2010; Gupta et al., 2010; Lockwood et al., 2015). Second, and relatedly, studies employ these constructs assuming they are reliable, valid, and discrete, though this has largely been untested in the literature (see Lockwood et al. 2015 for an exception measuring the dimensions of adaptive capacity in the Australian agriculture sector). Third, many authors assert that the collaborative governance and adaptability factors are inter-related, meaning they reinforce one another, yet this also has not been rigorously tested (Ansell and Gash, 2007; Cinner et al., 2018; Cristofoli et al., 2022; Emerson et al., 2012; Sharma-Wallace et al., 2018; Thomson and Perry, 2006). These gaps helped inform the objectives and analysis presented herein.

4.2 Materials and Methods

4.2.1 Data collection

We used Qualtrics, an online survey platform, to develop and administer a confidential survey to currently funded (as of December 2022) CFLRP projects (n=15). The survey addressed the following four questions:

1. Do participants feel the collaborative exhibits characteristics generally associated with healthy, well-functioning, and resilient collaboration?
2. To what extent do participants feel the project is meeting process, socio-economic, and ecological goals?
3. What do participants need or recommend to improve the process?
4. What are the perceived challenges that affect collaborative performance and durability?

Here, we focus on the survey items related to the first question in order to develop and test collaborative governance and adaptability constructs. Survey items were developed based on a review of

collaborative governance frameworks (Ansell and Gash, 2007; Biddle, 2017; Emerson and Nabatchi, 2015; Schultz et al., 2018; Ulibarri, 2015a) and literature on determinants of adaptive capacity (Cinner et al., 2018; Folke et al., 2005; Gupta et al., 2010). Survey item development was also informed by findings from the CFLRP (Beeton et al., 2022, 2020; Butler and Schultz, 2019; McIntyre and Schultz, 2020; Schultz et al., 2018). Additionally, items were adapted, where appropriate, from a variety of existing surveys in relevant peer-reviewed and grey literature (e.g., Biddle, 2017; Douglas et al., 2020a; Guariguata and Evans, 2020; Lockwood et al., 2015; National Forest Foundation, 2020; Plummer et al., 2017; Santo et al., 2020; Ulibarri, 2015a) (see supplementary material 1).

The collaborative dynamics section of the survey included sub-sections of indicators thought to measure the factors of principled engagement, shared motivation, and capacity for joint action. This section included 30 fixed-response items with a 5-point Likert response scale (strongly disagree to strongly agree). Respondents also had the option to select "don't know/not applicable."

Prior to administration, we piloted the survey with key members of the Colorado Front Range CFLRP (funded in 2012), the Northern Blues CFLRP (funded in 2021 and the first of the new cohort funded under the Agricultural Improvement Act of 2018), and CFLRP national program managers. This helped revise and refine the assessment. We then administered the survey to all members of the Northern Blues CFLRP and All-Lands Partnership in November 2021, and used responses and feedback from the CFLRP project members and coordinators to additionally refine the survey instrument.

After our initial pilot exercises, we engaged with and administered the survey to the remaining newly authorized and extension projects (n=14). National and regional CFLRP coordinators helped convene introductory webinars (n=4) in the fall of 2022 and spring of 2023 with project coordinators and members to review recruitment and administration protocols and identify the key points of contact from each project for follow-up engagement. For each CFLRP project, the authors coordinated several

meetings with key contacts to determine appropriate timing for administration, target population for recruitment, and the administration protocol.

The target population for each project varied, and in some cases was quite dispersed, given that multiple entities and organizations at multiple levels were involved in projects (e.g., Forest Service unit-level staff, county commissioners, national environmental NGOs). Our goal was to conduct a complete census of participants involved in, and knowledgeable about, the project's collaborative process to capture myriad experiences and perspectives of collaborative governance and adaptability (Bernard and Gravlee, 2015). We worked with CFLRP project coordinators to identify the target population, and project coordinators used participant listservs, or a listserv sub-set in the case where interested individuals and entities received emails about the project but were not active participants, for survey recruitment. The number of potential participants recruited by project varied considerably (n=37-205). The survey was administered to projects between November 2022 and May 2023. For each project, we left the survey open for 4-10 weeks, depending on local needs. Periodic reminders were sent out to enhance response rate. In total, 405 people responded to the survey, and 341 responded to the collaborative dynamics section specifically, representing a 24% response rate. Response rate varied by project (13-41%; Table 4.1) and is aligned with similar online surveys in the literature (Grosso and Van Ryzin, 2011; Kapucu et al., 2013; Ulibarri, 2015a). The survey and administration procedures were approved by our university Institutional Review Board (protocol # 2679).

4.2.2 Data analysis

All survey items used in our analysis consisted of a 5-point Likert response scale (strongly disagree to strongly agree). Likert scales are robust to standard statistical procedures; i.e., the items can be treated as continuous variables (Vaske, 2019). All analyses were performed in R (R Core Team 2022, version 4.3.1) and the Statistical Package for the Social Sciences (SPSS, IBM Corp., version 27).

4.2.2.1 Confirmatory Factor Analysis

We analyzed our data with confirmatory factor analysis (CFA). CFA assesses the relationships between indicators (i.e., survey items) and factors (i.e., latent variables, e.g., principled engagement) (Brown, 2015). CFA requires the pre-specification of all model parameters based on theory and previous empirical work (Brown, 2015; Vaske, 2019). We relied on existing theory and research regarding collaborative governance and adaptability to pre-determine indicator-factor relationships (see Section 2). CFA is an appropriate framework to confirm reliable scales and sub-scales, evaluate the presence of higher-order factors (i.e., a second-order model), and assess convergent and discriminant validity of constructs (Boateng et al., 2018; Brown, 2015). CFA was performed in R using the *lavaan* package (Rosseel, 2012).

We used maximum likelihood (ML) to estimate the CFA measurement model. Standard ML estimates assume the distribution of variables are multivariate normal. Data that departs substantially from multivariate normality requires the use of robust ML estimators, the most common of which are MLM (Satorra-Bentler scaled χ^2) and MLR (Yuan-Bentler T2* test statistic) (Satorra and Bentler, 1994; Yuan and Bentler, 2000). MLR has the added ability to estimate models that violate the assumption of multivariate normality and include missing data (Brown, 2015). There are many approaches to handling missing data. Direct ML, or full information ML, is considered the superior method in most cases to handle missing data, though it assumes the data is missing completely at random (MCAR) or missing at random (MAR) (Brown, 2015). Thus, to identify the appropriate estimator and method to handle missing data in our study, we conducted univariate and multivariate assessments of normality using the MVN package in R (Korkmaz et al., 2014) and a missing values assessment. Normality tests indicated our data exhibited multivariate non-normality (37.54, $p<0.01$). Since our data departed from multivariate normality, we used the *MissMech* package in R to assess MCAR and MAR (Jamshidian et al., 2014), which is derived from the non-parametric test developed by Jamshidian and Jalal (2010). We found insufficient evidence to reject the assumption of MCAR or MAR ($p=0.59$). Given our data can be

assumed MCAR or MAR, we used the full information ML method to handle missing data, and we estimated the measurement model using the robust MLR estimator (Yuan and Bentler, 2000).

We evaluated model fit using the recommendations from Brown (2015), which include assessing: 1) overall goodness-of-fit - we evaluated absolute (χ^2, χ^2/df, Standardized Root Mean Squared Residual [SRMR]), parsimony (Root Mean Square Error of Approximation [RMSEA]), and comparative (Comparative Fit Index [CFI], Tucker-Lewis Index [TLI]) fit indices; 2) localized areas of strain (standardized residuals and modification indices); and 3) interpretability, size, and statistical significance of the parameter estimates. This approach helped evaluate fit and consider options, if warranted based on theoretical and/or empirical grounds, for re-specification. We used standard thresholds to evaluate overall goodness-of-fit, including $\chi^2/df < 3$, SRMR and RMSEA $\leq$ 0.08, and CFI and TLI $>$ 0.9 (Boateng et al., 2018; Brown, 2015). Only statistically significant parameters were included in the measurement model.

We compared relative fit among three nested models consistent with the gaps identified in section 2 (Figure 4.2): 1) a first-order three factor model (i.e., principled engagement, shared motivation, capacity for joint action); 2) a first-order six factor model (i.e., principled engagement, shared motivation, leadership, resources, knowledge and learning, institutional arrangements); and 3) a second-order six factor model to test whether individual dimensions could be explained by a higher-order collaborative governance and adaptability construct (Emerson et al., 2012). Note it was not appropriate to test a second-order three factor model because the same number of parameters were estimated in the first-order three factor model, and thus the fit statistics were identical. Each model was compared using robust, scaled χ^2 values using the *SBSDiff* package in R (Mann, 2022), which is derived from the scaled χ^2 difference test developed by Satorra and Bentler (2010, 2001). We demonstrated fit using results of the scaled difference χ^2 test, CFA, TLI, SRMR, and Akaike Information Criterion and Bayesian Information Criterion (AIC and BIC, respectively).

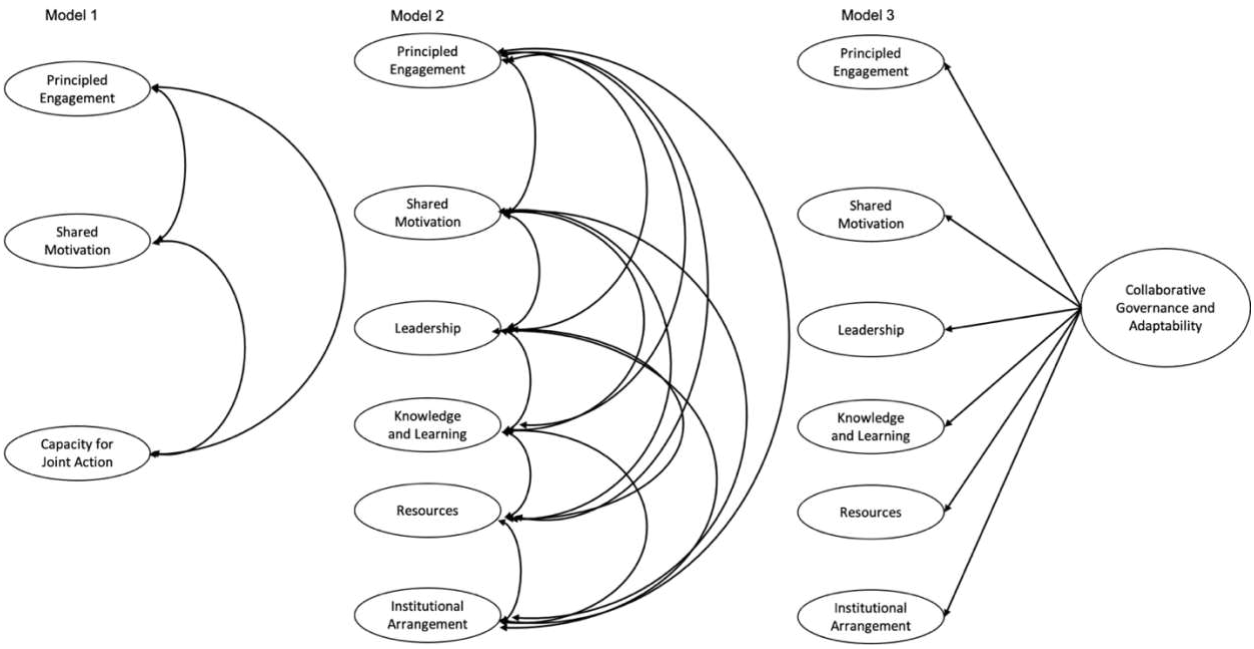

Figure 4.2: Nested models for comparison.

4.2.2.2 Assessing reliability and validity of the measurement model within the CFA framework

We assessed the reliability and convergent, discriminant, and predictive validity of factors that comprised the measurement model. We used the *SEMtools* package in R to evaluate composite reliability (CR). CR scores of ≥ 0.7 indicate a reliable scale for each factor in the measurement model (Nunnally and Bernstein, 1994). Convergent validity was evaluated using the following lines of evidence: standardized factor loadings (λ) ≥ 0.5, CR ≥ 0.7, and Average Variance Extracted (AVE) ≥ 0.5 (Fornell and Larker, 1981; Hair et al., 2014). We assessed discriminant validity by first evaluating correlations between factors – correlations ≥ 0.85 are considered potentially problematic in this context and require further testing. We supplemented the assessment of factor correlations with two nested model comparison methods, $\chi^2(1)$ and χ^2(merge). $\chi^2(1)$ is a nested model test where the correlation between two factors is fixed at 1 in a constrained model and compared to the original model, and χ^2(merge) refers to when two correlated factors are merged and then compared to the original model. These are appropriate approaches to assessing discriminant validity when theory and empirical research suggest higher inter-factor correlations, as is the case with the framework tested here (Rönkkö and Cho, 2022).

Next, we explored the predictive validity of our measures. Predictive validity, or the degree to which a measured concept accurately predicts scoring on a criterion measure, is useful for evaluating the practical utility of the concept (Murphy and Davidshofer, 2005; Manfredo et al., 2021; Teel and Manfredo, 2009). In a strict sense, predictive validity would be assessed by examining the extent to which the measured concept predicts an expected outcome in the future. An alternative, however, which can serve as an initial indication of the concept's predictive potential, is to test the association between the concept and a criterion of interest that is measured concurrently (i.e., at the same time). Taking the latter approach, we used correlation analysis (Spearman correlation, ρ) to assess: 1) the relationship between each factor and an index measuring perceived social process outcomes (CR = 0.89; AVE = 0.54, supplementary material 2); and 2) the relationship between each factor and an index measuring perceived ecological outcomes from collaboration (CR = 0.91; AVE = 0.585, supplementary material 2). We then evaluated the practical significance of correlation coefficients, with scores greater than or equal to 0.30 indicative of a moderate to large effect size (Cohen, 1988). We chose these outcome measures for our assessment on theoretical and empirical grounds. Scholars propose causal linkages between collaborative dynamics (e.g., principled engagement) and social and ecological outcomes (Emerson et al., 2012; Thomas and Koontz, 2011). Further, studies have demonstrated empirically the relationship between collaboration dynamics and both perceived and observed social and ecological outcomes (e.g., Biddle, 2017; Biddle and Koontz, 2014; Jager et al., 2020; Ulibarri, 2015a).

4.3 Results

4.3.1 Assessing the dimensional structure of collaborative governance and adaptability

Through evaluation of standardized factor loadings and significance, standardized residuals, and modification indices, the following actions were taken to respecify the models. First, we removed five items due to poor fit, which resulted in 25 remaining items. Two items in the shared motivation

dimension, two in the resources dimension, and one in the institutional arrangements dimension were removed (Table 4.2). Second, modification indices and residual analysis suggested adding a path (i.e., correlated error) between two items in the principled engagement dimension (PE3 – *Participants agree about the problems that impact our landscape*; PE4 – *Participants agree about the strategies to solve problems*). Adding a correlated error between two items implies some covariation between items is explained by something other than the theoretical relationship between the indicators and the factor, such as when items are similarly worded, as was the case here. All models satisfied the threshold for goodness-of-fit (Table 4.3). The nested models were then compared to determine which model best fit the data while considering parsimony.

Table 4.2: Item means, standard deviation, standardized factor loadings (l), composite reliability (CR), and average variance extracted (AVE) from CFA.

Factor (composite reliability; AVE)	Indicator	λ	*M*	*SD*
Principled Engagement	PE1. A representative cross-section of the individuals who have a stake in the issues and outcomes of this CFLRP project are involved.	0.64	4.1	1.11
(0.87; 0.56)	PE2. Participants work together to identify shared interests and concerns.	0.82	4.24	1.01
	PE3. Participants agree about key problems that impact our landscape.	0.70	4.03	1.04
	PE4. Participants agree about strategies to solve problems.	0.75	3.75	1
	PE5. Participants agree about the purpose of this CFLRP project.	0.77	4.2	0.99
	PE6. The collaborative process has created a neutral space to discuss controversial issues.	0.80	3.95	1.15
Shared Motivation	SM1. The collaborative process has helped participants build trust.	0.87	4.25	0.97
(0.91; 0.72)	SM2. The collaborative process has helped participants build personal and/or working relationships.	0.87	4.45	0.88
	SM3. The collaborative process has helped participants build mutual respect of others' positions and interests.	0.90	4.26	0.96
	SM4. Myself/my organization is committed to the CFLRP collaborative process.	0.69	4.64	0.75
	SM5. The US Forest Service is committed to the CFLRP collaborative process.[a]	-	-	-

	SM6. Other project participants are committed to the CFLRP collaborative process.[a]	-	-	-
Capacity for Joint Action				
Leadership	CJA1 (LD1). CFLRP project leaders have good skills for working with other people and organizations.	0.85	4.4	0.86
(0.89; 0.73)	CJA2 (LD2). CFLRP project leaders maintain and communicate a common collaborative vision and direction.	0.87	4.16	1.03
	CJA3 (LD3). CFLRP project leaders can motivate others to work together.	0.84	4.08	0.97
Knowledge and Learning	CJA4 (KNOW1). Participants co-generate knowledge and information to learn and solve problems.	0.81	4.11	0.95
(0.83; 0.56)	CJA5 (KNOW2). Knowledge and information is shared equally among CFLRP project participants.	0.70	3.84	1.15
	CJA6 (KNOW3). Project participants are committed to informing adjustments to management practices (i.e., adaptive management).	0.76	3.94	1.06
	CJA7 (KNOW4). Project participants have the flexibility to alter course when conditions change.	0.74	3.73	1.04
Resources	CJA8 (RES1). Our CFLRP project has adequate funds to carry out tasks and accomplish our work.[a]	-	-	-
(0.74; 0.59)	CJA9 (RES2). Our CFLRP project has adequate time to carry out tasks and accomplish our work.[a]	-	-	-
	CJA10 (RES3). Our CFLRP project has adequate technical expertise to carry out tasks and accomplish our work.	0.64	4.06	1.04
	CJA11 (RES4). Our CFLRP project has adequate skills to facilitate collaborative engagement activities.	0.88	4.09	1.04
Institutional Arrangements	CJA12 (IA1). Collaborative protocols are in place that promote accountability among CFLPR participants.	0.75	3.94	1.09
(0.89; 0.56)	CJA13 (IA2). Collaborative protocols are in place that promote accountability between the US Forest Service and CFLRP project participants.	0.74	3.69	1.15
	CJA14 (IA3). Collaborative protocols are understood by participants.	0.81	3.67	1
	CJA15 (IA4). Collaborative protocols are fair and equitable.	0.83	3.86	1.09
	CJA16 (IA5). Project participants clearly understand when and what collaborative input is useful to inform USDA Forest Service decisions.	0.72	3.54	1.1
	CJA17 (IA6). The US Forest Service is responsive to collaborative input.[a]	-	-	-
	CJA18 (IA7). The US Forest Service is clear about the decisions they make and why they make them.	0.63	3.75	1.13

[a] Removed from analysis due to poor fit. Model was respecified based on factor loadings, significance tests, standardized residuals, and modification indices.

The three nested models we tested are illustrated in Figure 4.2. The χ^2 difference test indicated that the more complex six factor model solution (model 2) was a better fit when compared to the first-order three factor model (model 1; $\Delta\chi^2 = 139.081$, $df = 12$, $p < 0.01$; Table 4.3). Further, when comparing the first-order models to the second-order six factor model (model 3), the second-order model significantly degraded model fit in both tests (Table 4.3; model 1 comparison - $\Delta\chi^2 = 67.17$, $df = 3$, $p < 0.01$; model 2 comparison - $\Delta\chi^2 = 50.83$, $df = 9$, $p < 0.01$). Thus, the second-order six factor model did not provide a more parsimonious fit to the data. The first-order six factor model (model 2) provided the best fit to our data. All measures of absolute, parsimony, and comparative fit indices support this conclusion (Table 4.3; $\chi^2/df = 1.77$; CFI = 0.951; TLI = 0.944; SRMR = 0.039; and RMSEA = 0.047).

Table 4.3: Nested model comparisons using scale-corrected chi-square difference test (Bryant and Satorra, 2012). See Figure 4.2 for visual representations of models 1-3.

Model	Model 1	Model 2	χ^2 difference: model 1 and 2	Model 3	χ^2 difference: model 1 and 3	χ^2 difference: model 2 and 3
χ^2	822.58	597.24		667.92		
scaled χ^2	623.66	457.57		510.71		
scaling correction factor	1.319	1.305		1.308		
df	271	259		268		
parameters	79	91		82		
χ^2/df	2.30	1.77		1.71		
$\Delta\chi^2$			139.08		67.17	50.83
Δdf			12		3	9
p-value			<0.001		<0.001	<0.001
CFI	0.910	0.951		0.941		
TLI	0.901	0.944		0.934		
SRMR	0.047	0.039		0.045		
RMSEA	0.076	0.057		0.062		
AIC(BIC)	1880	17879		17931		

	(18383)	(18227)		(18246)		

4.3.2 Assessing reliability and validity

For the final six factor model, standardized factor loadings ranged from 0.63 to 0.90, CR coefficients ranged from 0.74 to 0.91, and AVE ranged from 0.56 to 0.73 (Table 4.2). Together, these findings provide evidence of strong internal reliability and convergent validity of our measures.

As expected, several factors exhibited high inter-factor correlations (Table 4.4). Four correlations exceeded the 0.85 cutoff typically associated with potentially problematic discriminant validity (Brown, 2015), including for: 1) principled engagement and shared motivation; 2) principled engagement and knowledge and learning; 3) leadership and knowledge and learning; and 4) institutional arrangements and knowledge and learning. Yet, there isn't consensus on a strict cutoff for assessing discriminant validity. The expected magnitude of correlation among factors to diagnose a problem should be assessed based on theoretical and empirical grounds specific to the concepts being measured (Rönkkö and Cho, 2022). Thus, we further evaluated discriminant validity using two nested CFA model comparison approaches appropriate for when factors are expected to be highly correlated.

Table 4.4: Inter-factor correlations.

Factor	Principled Engagement	Shared Motivation	Leadership	Knowledge and Learning	Resources	Institutional Arrangements
Principled Engagement	-					
Shared Motivation	0.90	-				
Leadership	0.81	0.74	-			
Knowledge and Learning	0.89	0.80	0.91	-		
Resources	0.79	0.66	0.82	0.83	-	
Institutional Arrangements	0.78	0.70	0.77	0.86	0.74	-

We first fitted a constrained model where the potentially problematic factor correlations were fixed to 1 and compared to our original model (i.e., model 2 from Figure 4.2). We found that, for each factor pair, constraining the correlation to 1 significantly degraded model fit. In other words, the factor correlations of concern were significantly different from 1 ($\Delta\chi^2$ = 8.09-18.44, *df* = 1, p <0.01; Table 4.5). Second, we fitted a constrained model where the indicators representing the potentially problematic factor pairs were merged into a single factor and compared to the original model (see supplementary material 3 for χ^2(merge) nested model comparisons for each of the 15 possible factor pairs from the six factor model). Similarly, merging factors significantly degraded overall fit of our measurement model ($\Delta\chi^2$ = 33.83-66.18, *df* = 5, p <0.01; Table 4.5). Results of the nested model comparison provided evidence for discriminant validity between factors in our model. As a whole, these results provide evidence for convergent and discriminant validity, indicating that the components of collaborative governance and adaptability represent distinct constructs rather than dimensions of an underlying collaborative dynamics or adaptive capacity construct.

Table 4.5: Discriminant validity nested model comparisons. $\Delta\chi^2$ (1) is a test where the correlation between two factors is fixed at 1 in a constrained model and compared to the original model, and $\Delta\chi^2$ (merge) refers to when two correlated factors are merged and then compared to the original model.

	χ^2 (1)			χ^2 (merge)		
Factor Pair	$\Delta\chi^2$	*df*	p-value	$\Delta\chi^2$	*df*	p-value
Principled Engagement ~~ Shared Motivation	8.09	1	<0.01	39.45	5	<0.001
Principled Engagement ~~ Knowledge and Learning	14.73	1	<0.001	53.72	5	<0.001
Leadership ~~ Knowledge and Learning	15.73	1	<0.001	33.83	5	<0.001
Institutional Arrangements ~~ Knowledge and Learning	18.44	1	<0.001	66.18	5	<0.001

Results of our predictive validity tests (Spearman correlation, ρ) showed that correlation coefficients between each factor and reported social process and ecological outcomes were all significant at the $p < 0.001$ level. Further, the strength of association for each correlation coefficient was moderate to strong (Table 4.6). Together these findings provide further empirical evidence for the validity of our measures.

Table 4.6: Predictive validity analyses for six collaborative dynamics dimensions.

	Principled Engagement	Shared Motivation	Leadership	Knowledge and Learning	Resources	Institutional Arrangements
Social process outcomes[a]	0.726[b]	0.672[b]	0.689[b]	0.751[b]	0.601[b]	0.725[b]
Ecological outcomes[a]	0.462[b]	0.339[b]	0.397[b]	0.469[b]	0.426[b]	0.484[b]

a. Spearman's ρ correlation coefficient
b. $p<0.001$

4.4 Discussion

4.4.1 Implications

In this section, we summarize the implications of our findings for the theory and practice of collaborative governance and adaptability organized around our study objectives. First, there is little consensus on the number and configuration of factors that comprise collaborative governance and adaptability (Emerson et al., 2012; Koontz et al., 2015; A.R. Siders, 2019). Koontz et al. (2015) note that there are many frameworks and variables purported to cultivate collaborative governance and adaptability. Yet, differences in how they are defined, configured, and measured limits our understanding of their underlying relationship and our ability to test and advance theory. Similar critiques exist in the social learning literature (Gerlak et al., 2019; Gerlak and Heikkila, 2019), and more broadly in the adaptive governance and adaptive capacity literature (Biesbroek et al., 2017; A.R. Siders, 2019).

As a starting point for addressing these limitations, our first objective was to test the dimensional structure of the integrative framework for collaborative governance proposed by Emerson et al. (2012),

and expounded upon by Emerson and Gerlak (2014) to link collaborative and adaptive capacity for joint action. Emerson et al.'s (2012) framework comprises three factors associated with collaborative governance dynamics – principled engagement, shared motivation, and capacity for joint action. In our study, we found that the principled engagement and shared motivation factors aligned well with the integrative framework for collaborative governance. However, our results suggest the capacity for joint action dimensions – leadership, knowledge and learning, resources, and institutional arrangements – represent related, but distinct, factors. In other words, in the context of the CFLRP, the four factors could not be considered part of the underlying construct capacity for joint action as proposed in Emerson et al. (2012). Additionally, our results indicated that a second-order model significantly degraded the model fit when compared to both the three and six factor models, which suggest that the factors could not be explained by a larger underlying construct of collaborative dynamics. These findings align with other frameworks and empirical work (Ansell and Gash, 2007; Douglas et al., 2020a; Gupta et al., 2010). Thus, our results confirmed the dimensional structure of our collaborative governance and adaptability measures comprised six dimensions – principled engagement, shared motivation, leadership, resources, knowledge and learning, and institutional arrangements.

Second, studies deploy collaborative governance and adaptability measures assuming they represent valid and discrete constructs, an assumption that has been largely untested. Here, we used several lines of evidence to test the reliability, as well as the convergent, discriminant, and predictive validity of our collaborative governance and adaptability measures. In this vein, it is widely suggested that the dimensions of collaborative governance and adaptability are interrelated, as they are said to be mutually-reinforcing (Ansell and Gash, 2007; Emerson et al., 2012; Folke et al., 2005; Pahl-Wostl et al., 2007). As expected, we found that the six dimensions of our measurement model were indeed interrelated. Four dimensions were highly correlated, and the pattern of inter-factor relationships aligned with theoretical and empirical work. Notably, principled engagement and shared motivation were highly correlated. Emerson et al. (2012) suggest outcomes of principled engagement can include increased trust,

mutual understanding, and internal legitimacy, which are the key elements of shared motivation. Further, knowledge and learning were highly correlated with principled engagement, leadership, and institutional arrangements. This finding aligns with Pahl-Wostl et al.'s (2007) depiction of the relationship between social learning and other collaboration components. Social learning, according to Pahl-Wostl et al. (2007), shapes, and is shaped by, the relational components of collaboration. Social learning is thought to be effective under open venues for communication and negotiation, strong leadership, and clear ground rules for engagement.

Our measures of collaborative governance and adaptability exhibited strong internal reliability and convergent validity. While the measures were statistically related, they can be considered distinct constructs, as evidenced by our discriminant validity assessment. Further, we found preliminary evidence for predictive validity of our measures. Each of our measures were significantly related to perceived social process and ecological outcomes. Ulibarri (2015a) demonstrated that collaboration dynamics were related to perceived outcomes, and specifically were more strongly related to the more proximal social process outcomes when compared to ecological outcomes. The strength of associations between our collaboration dynamics scales and outcomes aligns with this work. Overall, results suggest the six factors in our final model represent statistically reliable and valid measures that may be used to evaluate collaborative governance and adaptability.

4.4.2 Limitations of the present study and future work

A limitation to consider for this work is that the survey was developed for a specific context, the CFLRP. We developed measures that were grounded in the research and practice of the CFLRP and unique to collaboration in U.S. public land management to ensure measurement specificity and relevance (Conley and Moote, 2003). While our focus is on the CFLRP, we believe that the framework, survey instrument, and methods are applicable to other cross-boundary collaborative environmental governance contexts. However, the instrument could benefit from further refinement, adaptation, and testing in different cases

and contexts to determine if the survey items are locally- and contextually-appropriate, and if the dimensional structure, pattern of factor relationships, and reliability and validity of measures remain consistent with results from this study. In particular, there may be room for refining items to reflect the unique ways in which Tribes engage with public lands management agencies. The Forest Service engages with Tribes who are distinctive rightsholders and sovereign nations; some Nations have chosen to engage through the CFLRP collaborative framework while others work directly with the Forest Service in government-to-government consultation. Future surveys in the CFLRP or other public lands management collaborative venues may require additional attention to these histories, differences, and relationships among interested entities and distinct rightsholders.

Collaborative governance regimes are nested within broader social, political, economic, and ecological contexts, and the progress and performance of collaboration is impacted by both internal and external factors. While a great deal of research has described different components of collaboration, there is less understanding of the relationships between collaborative processes and social-ecological outcomes, and how different systems contexts and drivers affect collaborative process dynamics (Douglas et al., 2020b; Emerson and Nabatchi, 2015; Ulibarri, 2015a). Some notable research has started to address linkages between collaborative dynamics and outcomes (Baudoin and Gittins, 2021; Biddle and Koontz, 2014; Koontz et al., 2020; Ulibarri, 2015a, 2015b; Wang and Zhao, 2021). The framework we used to determine measures of collaborative governance and adaptability is a nested, systems-based framework that proposes causal linkages between system components (Emerson et al. 2012). It thus provides an opportunity to further contribute to our understanding of the relationship between external social-ecological contexts, drivers, dynamics, and outcomes. A fruitful line of inquiry lies in using methods like qualitative comparative analysis to characterize which and what configuration of collaborative process variables may lead to successful outcomes in different contexts (Avoyan, 2022a; Cristofoli et al., 2022; Douglas et al., 2020b).

Additionally, the majority of research linking collaborative dynamics to outcomes has focused on more proximal collaborative actions (e.g., development of management plans, monitoring, implementation) and process-related outcomes (e.g., minimize conflict, new relationships, process effectiveness). There are challenges, however, to measuring socio-economic and ecological outcomes of collaboration. In particular, actions taken by collaboratives are often temporally disjunct from outcomes on the ground and thus difficult to establish causality. Addressing this gap would thus require baseline and longitudinal research, which is relatively limited in the collaborative governance arena (Conley and Moote 2003, Ulibarri et al. 2020; Ansell and Gash 2007). There is a need to evaluate the impact of collaboration on the more distal social and environmental outcomes that collaboratives are asked to achieve (e.g., socio-economic stability, improved resource conditions) (Ansell and Gash, 2007; Baudoin and Gittins, 2021; Koontz et al., 2020). In this vein, intermediate process-related outputs and collaborative actions can determine the type and extent of outcomes and impacts. In other words, these actions, outcomes, and impacts are inextricably linked, occurring as a path-dependent trajectory of change (Koontz et al. 2020; Emerson et al 2012). Evaluating the complex and causal linkages between collaboration dynamics and outcomes could be achieved using standardized frameworks and assessments like the one presented here or others (e.g., Newig et al., 2018), cross-case meta-analyses, or rigorous within-case methods like process tracing (Avoyan, 2022b; Koontz et al., 2020; Ulibarri, 2015b). Structural equation modeling, and path analysis in particular, may provide a useful approach for assessing the degree to which intermediate process-related outcomes and actions mediate the more distal outcomes and impacts of collaboration (Biddle and Koontz, 2014; Jager et al., 2020; Mosley and Park, 2022).

Collaboratives evolve and adapt their structures and processes as priorities, capacities, and the public value they provide change (Imperial, 2022; Imperial et al., 2016; Ulibarri et al., 2020). However, there is a limited understanding of how collaborative groups adapt collaborative structures, practices, and processes to maintain their progress and performance (Cheng et al., 2015; Imperial, 2022; Ulibarri et al., 2020). The limited research on collaboration over time has suggested that participation and engagement

decrease through time (Heikkila and Gerlak, 2016; Hui et al., 2020). Some argue that trust and personal relationships (i.e., shared motivation) may be more important in the early phases of collaboration until the group is institutionalized (Imperial et al., 2016). Ulibarri et al. (2020) conducted an analysis of collaborative governance and evolution using the Collaborative Governance Database (Douglas et al., 2020a) and found that most of the collaboration dynamic variables peaked towards the mid-point; a focus on transparency and accountability was observed later in the collaboration life-cycle; and leadership tended to be concentrated early on, but more distributed in later phases of the collaborative life-cycle. Ulibarri et al. (2020) also found some evidence of the importance of conflict resolution (process outcome) at the beginning of the collaborative life-cycle compared to innovative solutions and effectiveness, for example, in later phases. Systematic, cross-case assessments through time can help document: 1) what collaboration governance dynamics are important and when; 2) what adaptations and outcomes occur over time; and 3) how collaborative processes and intermediate outputs influence social and ecological outcomes that may be temporally disjunct from the collaborative process.

The assessment presented here is part of the CFLRP common monitoring strategy. Newly authorized projects are required to address the common monitoring strategy for 15 years, thus offering a unique opportunity to study collaborative governance and adaptability through time and across projects within a natural experimental setting, where each project is situated within diverse social and environmental contexts, but all under the same policy instrument (Ansell and Gash, 2007). There are currently no gold-standard criterion variables from which to evaluate our scales, an oft-cited challenge to validity assessment (Boateng et al. 2018). Still, there is room for further testing of the predictive validity of our scales by assessing their association with observed social and ecological outcomes reported in the CFLRP common monitoring strategy. Further, mixed-methods research that pairs systematic quantitative analyses with in-depth case studies and qualitative inquiries would be particularly beneficial to gain sufficient depth and breadth in understanding collaborative governance and adaptability in the complex,

social-ecological systems in which collaborative governance regimes are embedded (Ansell and Gash, 2007; Conley and Moote, 2003).

4.5 Conclusion

In conclusion, we administered a survey grounded in the theory and practice of collaborative governance and adaptability to fifteen projects authorized and funded under the CFLRP and administered by the Forest Service in the United States. We used confirmatory factor analysis to test propositions related to the dimensional structure, reliability, and validity of our collaborative governance and adaptability measures. Several of these assumptions had been largely untested in the literature. We confirmed the dimensional structure of our collaborative governance and adaptability measures comprised six reliable and valid factors. As anticipated, several factors were interrelated. Still, our discriminant validity assessment suggested the factors comprised distinct constructs. We argue that the results presented herein offer a set of robust collaborative environmental governance and adaptability measures that can be further refined, adapted, and tested. While our initial focus was on the collaborative groups funded under the CFLRP, the framework, survey instrument, and methods are applicable to other collaborative environmental governance arrangements. The assessment can be used in the future as a baseline with which to contribute to our limited understanding of how collaborative dynamics relate to social and environmental outcomes (Koontz et al., 2020) and how collaborative groups adapt collaborative structures, practices, and processes under change to maintain their progress and performance (Cheng et al., 2015; Imperial, 2022; Ulibarri et al., 2020). This is a critical line of work given the increased emphasis and reliance on long-term collaborative arrangements with multiple interested and affected parties to achieve sustainability goals.

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CHAPTER 5: CONCLUSION

5.1 Summary of results

The interest in, and demand for, collaborative and adaptive environmental governance arrangements continues to increase as they are claimed to minimize conflict and uncertainty, and address complex, wicked problems that cannot be achieved alone. Despite over twenty years of research in this space, and significant contributions in understanding external drivers and social-ecological conditions that influence collaborative governance, the internal collaborative dynamics that facilitate "good" governance, and the outcomes of collaboration, a number of research gaps remain. First, the ways in which collaboratives adapt and remain resilient is under-explored. Second, there is a lingering need for periodic, sustained evaluation of collaboratives to determine the adaptations that are needed to continue making progress as they evolve. Third, there is no consensus on, and little formal testing of, empirical measures that comprise collaborative governance and adaptability, which, in turn, limits systematic comparison across cases.

This dissertation started to address these shortcomings, and was broadly concerned with the factors that facilitate or frustrate adaptation to inevitable change in collaborative settings. I situated this assessment within the Collaborative Forest Landscape Restoration Program (CFLRP). The CFLRP is administered by the USDA Forest Service and provides sustained funding for up to 10 years for projects to work collaboratively from direction-setting to implementation and use the best available science to accomplish forest and fire management goals. I employed a mixed method approach, which consisted of a systematic review, surveys, focus groups, qualitative data analysis, and confirmatory factor analysis.

Chapter 2 took a retrospective look at CFLRP projects first funded in 2010 and 2012-2013. I focused on how collaborative groups adapted to common disruptions (personnel turnover, biophysical disruptions, legal or policy change) and the social and institutional barriers that challenged adaptation.

Findings indicate CFLRP projects adapted to disruptions in a number of ways. They coordinated field trips, onboarding workshops, joint fact-finding, monitoring, and adaptive management, which helped build trust and relationships among existing and new members, build shared understanding of restoration needs, evaluate how wildfire and pest disturbances impacted forest health, and temper conflict. They also co-developed collaborative documents (e.g., restoration strategies, design criteria, charters) to institutionalize expectations for collaborative engagement, decision making, and social learning. Groups flexibly navigated disruptions by shifting restoration work to other planning units or jurisdictions. Yet, adaptation was constrained by limited authority over decision making on Forest Service-managed land, variable commitment to collaboration, and limited capacity to engage. Collaboration in the CFLRP context is nested within a hierarchical, bureaucratic organizational structure of the Forest Service, which has decision authority over management actions. Thus, actionable adaptations are contingent upon and must align with existing rules, regulations, and protocols (Abrams et al., 2017; Beeton et al., 2022; Cheng et al., 2015; Schultz et al., 2021).

Chapters 3 and 4 utilized data from a program-wide CFLRP survey, grounded in the theory and practice of collaborative governance and adaptability. It was administered to all newly authorized and reauthorized projects since 2021 (n=15). In chapter 3, I conducted a qualitative data analysis of respondents' (n=168) recommended actions and adaptations needed to improve collaborative processes and continue progress towards desired outcomes. Findings suggested projects were dealing with multiple challenges simultaneously and recommended: additional venues for inclusive engagement throughout the restoration process; clear, responsive, and accountable institutional arrangements that codified decision making processes, conflict resolution, and shared recommendations for implementation actions; investments in financial and personnel capacity, particularly for collaborative capacity building; robust monitoring protocols and opportunities for shared learning and collaborative

adaptive management; increased trust, relationships, and particularly commitment among partners; increased outreach to the broader public; and local autonomy in decision making to reduce barriers to implementation.

Chapters 2 and 3 together provide several policy and practice recommendations to consider. First, collaborative processes benefit from inclusion of diverse perspectives and interests. Respondents recommended more inclusion of Tribes, land grants, local communities and governments, private landowners, recreation groups, conservation and environmental organizations, non-governmental organizations, and/or local businesses. Yet, there are many factors that determine whether an entity engages, and there is an inherent tension between inclusion and efficiency. Inclusion should be managed based on local context, collaborative history, and current and expected needs. Second, early and frequent collaborative engagement from direction-setting to implementation can help document decision space and authority, build trust and shared understanding around management goals, help participants understand how and when to inform decisions, and articulate what decisions are made and why they are made. Collaborative spatial wildfire planning tools and platforms, annual monitoring workshops, and qualitative field reviews are just a few ways to engage collaborative groups throughout the process, while clear "plug-in points" ensures participants know how and when to engage. Third, collaboratively developed documents (e.g., restoration strategies, charters) can help institutionalize joint knowledge production, social learning, and accountability among collaborative members and between collaborative members and the Forest Service. When possible, these collaboratively-developed documents should be codified in agency procedures and protocols. Fourth, change is a fundamental and recurring aspect of collaboration. Turnover can erode trust and stall progress; new faces can alter expectations, commitments, or capacities to engage; policy changes can shift priorities; and wildfires or other biophysical changes can divert resources. Change is not inherently positive or negative but

adequate preparation for change can facilitate collaborative progress. As such, collaboratives may benefit from developing transition strategies to institutionalize and align expectations and commitment. Collaboratively developed documents should be periodically revisited to institutionalize joint knowledge production and learning and ensure these governance processes meet the needs of collaboratives and desired outcomes over time. Fifth, the most commonly noted limiting factors of collaboration are sufficient time and funding. Currently, the CFLRP only funds a portion of implementation and monitoring activities. It does not provide funding for collaborative capacity building. Therefore, there is a need for supplemental funding to support third-party facilitators, technical assistance, researchers, and leaders to help coordinate activities, manage communication and conflict among participants, and facilitate social learning and collaborative adaptive management processes, all of which are critical for cultivating collaborative adaptability and resilience. Finally, developing a culture of collaboration in the Forest Service, where agency staff have the capacity, direction, and incentives to commit to the collaborative process, may help sustain productive forest and fire management across boundaries and over time. Training in collaboration, providing promote-in-place opportunities, hiring partnership liaisons, and including collaborative activities in job requirements and evaluations are a few ways to promote the requisite competencies and commitment to collaboration. Several of the these recommendations are persistent collaboration challenges that have been observed since the early 2000s (Margerum, 2007; Margerum and Robinson, 2016; Moote and Becker, 2003; Wondolleck and Yaffee, 2000). They were key challenges mentioned during the first 10 years of CFLRP (Chapter 2), and the challenges persisted in newly authorized and reauthorized CFLRP projects today (Chapter 3). These should be addressed in order to support durable, healthy, and resilient collaboration.

Chapter 4 used the CFLRP survey from chapter 3 and confirmatory factor analysis to test the dimensional structure, reliability, and validity of measures thought to comprise collaborative governance

and adaptability. We confirmed the dimensional structure comprised six collaborative dynamic dimensions – principled engagement, shared motivation, leadership, resources, knowledge and learning, and institutional arrangements. Several scholars propose that collaboration dynamics are "mutually-reinforcing," however these assumptions have largely been untested in a robust statistical framework (Ansell and Gash, 2007; Emerson et al., 2012). I found that several of the dimensions were indeed inter-related and the patterns of correlations aligned with assumptions in the literature. The dimensions were statistically reliable, valid, and distinct measures that may be used to assess collaborative governance and adaptability through time and across cases.

5.2 Limitations of current study and future research

A limitation of the current study is that it is couched within a specific context, the CFLRP. For example, the survey employed in chapters 3 and 4 was informed by findings from the first ten years of the CFLRP (Beeton et al., 2020; Butler and Schultz, 2019). Future work is needed to adapt, refine, and test the assessment in diverse collaborative environmental governance settings. Research empirically relating internal collaborative process dynamics to collaborative actions and outcomes remains underexplored (Douglas et al., 2020; Koontz et al., 2020). Even less research has related those dynamics to the distal social and ecological outcomes collaboratives are increasingly asked to achieve (Koontz et al., 2020). In the CFLRP, for example, desired outcomes include reducing wildfire risk to communities, increasing fire use, accomplishing more work on adjacent lands, and improving watershed function. There are many reasons for which research is lacking in this space. Many desired outcomes take years to realize and thus may be temporally disjunct from, and hence difficult to attribute to, any one collaborative process (Ansell and Gash, 2007; Baudoin and Gittins, 2021; Koontz et al., 2020; Rodela, 2011). Further, the link between collaborative processes and outcomes may be mediated by intermediate outputs and actions, which has largely been ignored in the literature (c.f., Ulibarri, 2015).

In this vein, another oft-cited limitation of collaborative governance and adaptability research is that most research, including this dissertation, relies on point-in-time-assessments. Point-in-time assessments are necessary but not sufficient for understanding the dynamic and evolving nature of collaboration (Ansell and Gash, 2007; Bingham and O'Leary, 2006; Cheng et al., 2015). The limited longitudinal research has found that participation and engagement decrease through time, and suggest trust- and relationship-building may be more important early in a collaborative process, while the development of transparent, accountable institutional arrangements may be more important in later stages. Yet, the network governance literature tells us that collaboratives go through non-linear stages throughout their lifecycle, may be dealing with multiple issues at different stages simultaneously, and/or need to revert back to early stages when people or priorities change (Imperial et al., 2016). In short, there is still limited understanding of how collaboratives adapt and evolve through time (Ulibarri et al., 2020). Hence, there is a need for systematic, cross-case longitudinal research.

Finally, an oft-cited critique of resilience and adaptive governance design principles is that they are normative, the assumption being adopting principles of adaptive governance will result in resilient collaboratives and sustainable outcomes (Biesbroek et al., 2017; Cote and Nightingale, 2012). As Biesbroek et al. suggest "emphasis in most of this literature is placed on the normative question of how things ought to be, rather than explaining how things are and why they are" (2017: 6). Cote and Nightingale (2012) argue that design principles alone cannot explain how groups adapt and remain resilient to change, and work should be supplemented with "situated" assessments of the complex social, cultural, and political contexts of local communities. Mixed methods research pairing systematic quantitative analyses with in-depth qualitative case studies are needed to garner sufficient understanding of local adaptation and resilience. Next, I describe future research efforts in this space that build on the methods and findings presented in this dissertation and address several of the limitations and research needs described above.

5.3 Developing a systematic, longitudinal, cross-case social science research program in collaborative governance and adaptability

The work presented in this dissertation was co-developed with the Southwest Ecological Restoration Institutes and the Forest Service Forest, Range Management, and Vegetation Ecology staff. We were asked to develop and administer a collaborative governance assessment across projects and through time (10-15 years) as part of the CFLRP Common Monitoring Strategy. We have established an initial network of sites (n=15) that are embedded within local socio-cultural, political, economic, and environmental contexts but under the same policy instrument, thus providing a unique opportunity to study collaboration in a natural experimental setting (Ansell and Gash, 2007).

We are in the process of co-developing a long-term cross-case social science research program on collaborative governance and adaptability. We are proposing to conduct an explanatory, mixed method and multi-level research design (Creswell, 2022). The aim is to conduct program- and project-level assessments, and to link program-wide survey data, in-depth case studies, document review, and focus groups. Throughout this dissertation, I operationalized the Integrative Framework for Collaborative Governance (Emerson et al., 2012), which is a nested, systems based framework that proposes causal linkages between external system contexts and drivers, internal collaborative dynamics, and the collaborative actions, adaptations, and outcomes collaboratives produce. Using this framework and a variety of methodologies, including process tracing, qualitative comparative analysis, and structured equation modeling (Avoyan, 2022; Biddle and Koontz, 2014; Douglas et al., 2020; Jager et al., 2020), represent promising approaches to address lingering questions in research and practice. For example, how do collaboratives navigate multiple, overlapping, and changing policy directions and investments? How are internal collaborative dynamics associated with one another, and how does the relative importance of collaborative dynamics change through time? How do the actions and adaptations needed fluctuate through time? To what extent is there flexibility in the system to adapt collaborative structures

and processes? Which actions and adaptations are feasible and desirable given variable, conflicting, and changing motivations, expectations, commitments, and accountabilities? What actions and adaptations taken at one point in time cultivate or constrain progress, actions, and adaptability in the future? What collaborative dynamics, or combination thereof, are associated with collaborative outcomes? These are critical questions to address. They have been under-explored in the literature and have practical applications to collaborative governance regimes as investments in long-term collaborative efforts to meet forest and fire management goals continue to increase.

5.4 Final thoughts

This dissertation was concerned with understanding the factors that facilitate or frustrate adaptation to inevitable change in collaborative settings. Findings provided empirical evidence of several persistent challenges to collaboration that must be addressed to cultivate collaborative adaptability. I provided policy and practice recommendations that may be considered to help address these persistent challenges. I developed empirically and theoretically grounded measures of collaborative governance and adaptability that are reliable and valid, which can be used to assess collaboration through time and across cases. Finally, this dissertation lays the groundwork for a long-term social science research program on collaborative adaptability, and thus paves the path for addressing some of the persistent challenges of, and lingering questions about, collaborative environmental governance under change.

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APPENDICES

Appendix 1. List of documents in literature review used for analysis (Chapter 2).

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Appendix 3. Collaborative resilience worksheet used for focus groups (Chapter 2).

How resilient is your collaborative? Assessing the vulnerability and adaptive capacity of collaborative groups to internal and external change

In your breakout group, use this worksheet to:

- discuss and learn about the internal and external changes collaboratives have experienced;
- the associated impacts to collaborative function and performance;
- the ways in which collaboratives have dealt with these changes across cases and contexts;
- barriers that constrain response; and
- best practices that have facilitated response.

What internal or external change(s) has the collaborative group you are affiliated with experienced? *These could include: 1) turnover in participants; 2) the transition from direction-setting to implementation; 3) notable ecological disturbance; 4) sudden change in industry capacity; and/or 5) a legal or policy change, among others.*	How have these changes impacted collaborative function or performance? *These may include both positive changes or negative impacts. For example, participant turnover may have resulted in new opportunities for collaborative progress. Conversely, turnover may have caused set-backs in getting to agreement or delays in implementation.*	In what ways have you prepared for, responded to, or mitigated impacts from these changes? Please provide examples. *These could include: 1) developing a transition strategy (e.g., written agreements guiding restoration treatments, onboarding material, a buddy system, or redundancy in roles); 2) enabling collaborative involvement early and often throughout planning and implementation phases; 3) augmenting prescriptions, planning areas, or priorities in the event they are affected by wildfire, among others.*	What barriers or constraints inhibited your ability prepare for or respond to these changes? Please provide examples. *These could include: 1) lack of knowledge or experience about how to anticipate, plan for, or anticipate surprises; 2) lack of time – too many other issues to deal with; 3) lack of leadership within the collaborative; 4) lack of power, authority, or resources to affect change.*

Appendix 4: Recommendation themes by extension and newly authorized projects, agency and non-agency respondents, and project (Chapter 3).

Table A4.1: Recommendation themes by extension (reauthorized) and newly authorized projects. Numbers reflect the frequency of mentions (and percentage).

Theme	Extension projects	New projects
Institutional arrangements	**17 (18%)**	**28 (21%)**
Monitoring and social learning	8 (9%)	13 (9%)
Resources and capacity	**13 (14%)**	**31 (23%)**
External communication and outreach	3 (3%)	8 (6%)
Inclusive engagement	**42 (46%)**	**45 (33%)**
Local autonomy in decision making	2 (2%)	1 (1%)
Trust, relationships, and commitment	7 (8%)	10 (7%)
Total	92 (100%)	136 (100%)

Table A4.2: Recommendation themes by Forest Service and non-agency respondents. Numbers reflect the frequency of mentions (and percentage).

Theme	Forest Service (Agency)	Non-agency
Institutional arrangements	**14 (20%)**	**31 (21%)**
Monitoring and social learning	7 (10%)	12 (8%)
Resources and capacity	**11 (15%)**	**31 (21%)**
External communication and outreach	0 (0%)	11 (7%)
Inclusive engagement	**34 (48%)**	**52 (34%)**
Local autonomy in decision making	1 (1%)	2 (1%)
Trust, relationships, and commitment	4 (6%)	12 (8%)
Total	71 (100%)	151 (100%)

Table A4.3: Recommendation themes by project. Numbers reflect the frequency of mentions (and percentage).

	Institutional arrangements	Monitoring and social learning	Resources and capacity	External communication and outreach	Inclusive engagement	Local autonomy in decision making	Trust, relationships, and commitment	Totals
Deschutes Collaborative Forest Project	3 (14%)	1 (4%)	4 (18%)	0 (0%)	**9 (41%)**	0 (0%)	**5 (23%)**	22
Dinkey Collaborative	**2 (18%)**	**2 (18%)**	0 (0%)	0 (0%)	**6 (55%)**	0 (0%)	1 (9%)	11
Lakeview Stewardship	1 (14%)	**2 (29%)**	1 (14%)	0 (0%)	**3 (43%)**	0 (0%)	0 (0%)	7
Missouri Pine-Oak Woodland Restoration	0 (0%)	1 (14%)	**2 (29%)**	1 (14%)	**3 (43%)**	0 (0%)	0 (0%)	7
North Central Washington	**5 (63%)**	0 (0%)	**2 (25%)**	0 (0%)	1 (12%)	0 (0%)	0 (0%)	8
North Yuba Forest Partnership	2 (13%)	**4 (25%)**	3 (19%)	0 (0%)	**6 (37%)**	0 (0%)	1 (6%)	16
Northeast Washington Forest Vision 2020	**3 (38%)**	0 (0%)	**2 (25%)**	0 (0%)	**2 (25%)**	0 (0%)	1 (12%)	8
Northern Blues	4 (11%)	5 (14%)	**10 (29%)**	3 (9%)	**12 (34%)**	0 (0%)	1 (3%)	35
Rio Chama	4 (18%)	0 (0%)	**6 (27%)**	3 (14%)	**9 (41%)**	0 (0%)	0 (0%)	22
Rogue Basin Landscape Restoration Project	0 (0%)	**2 (15%)**	**2 (15%)**	0 (0%)	**8 (62%)**	0 (0%)	1 (8%)	13
Shortleaf Bluestem	**2 (20%)**	0 (0%)	0 (0%)	1 (10%)	**6 (60%)**	1 (10%)	0 (0%)	10
Southern Blues Restoration Coalition	**6 (30%)**	2 (10%)	1 (5%)	0 (0%)	**11 (55%)**	0 (0%)	0 (0%)	20

Southwest Colorado Restoration Initative	**12 (60%)**	0 (0%)	**4 (20%)**	0 (0%)	3 (15%)	0 (0%)	1 (5%)	20
Western Klamath Mountains Forest and Fire Resiliency	1 (5%)	2 (9%)	4 (18%)	2 (9%)	**6 (27%)**	1 (5%)	**6 (27%)**	22
Zuni Mountains	0 (0%)	0 (0%)	**3 (43%)**	1 (14%)	**2 (29%)**	1 (14%)	0 (0%)	7
Totals	45 (100%)	21 (100%)	44 (100%)	11 (100%)	87 (100%)	3 (100%)	17 (100%)	228 (100%)

Appendix 5. Surveys used to inform CFLRP collaborative governance and adaptability assessment (chapter 4).

Author	Year	Title	Link (if applicable)
Douglas et al.	2020	Understanding Collaboration: Introducing the Collaborative Governance Case Databank	https://academic.oup.com/policyandsociety/article/39/4/495/6404009
National Forest Foundation	2020	Collaborative Forest Landscape Restoration Program 2020 collaboration indicator survey results	https://www.nationalforests.org/assets/pdfs/Collaboration-Indicator-Survey-Results-2020-publish.pdf
Plummer et al.	2017	Diagnosing adaptive co-management across multiple cases	https://www.ecologyandsociety.org/vol22/iss3/art19/
Evans and Guariguata	2019	A diagnostic for collaborative monitoring in forest landscape restoration	https://onlinelibrary.wiley.com/doi/full/10.1111/rec.13076
Santo et al.	2020	Implementing Outcome-Based Performance Measures aligned with the Forest Service's Shared Stewardship Strategy	https://static1.squarespace.com/static/562e839ee4b0332955e8143d/t/5f8e0dfb7b4bed21bccfb972/1603145298059/Performance+Measures_v4_10_13_20_web.pdf
US Forest Service, National Partnership Office		US Forest Service Partnership Capacity Assessment Tool	https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd493263.pdf
Ulibarri	2015	Collaboration in federal hydropower licensing: impacts on process, outputs, and outcomes	https://www.tandfonline.com/doi/full/10.1080/15309576.2015.1031004
Biddle	2017	Improving the effectiveness of collaborative governance regimes: Lessons from watershed partnerships	https://ascelibrary.org/doi/10.1061/%28ASCE%29WR.1943-5452.0000802
Lockwood et al.	2015	Measuring the dimensions of adaptive capacity: a psychometric approach	https://www.ecologyandsociety.org/vol20/iss1/art37/
Wyckoff	2020	Rogue Forest Partners Draft Evaluation Form	
Esch and Vosick	2016	Four Forests Restoration Initiative self-survey	https://cdm17192.contentdm.oclc.org/digital/collection/p17192coll1/id/271/rec/12
Thomas and Koontz	2015	Do Collaborative Groups Enhance Interorganizational Networks?	https://www.tandfonline.com/doi/full/10.1080/15309576.2015.1031008

Appendix 6. Process outcomes survey items (Chapter 4)

The following statements assess outcomes from the collaborative process, and your recommendations to improve the collaborative process and maintain collaborative progress. These survey items were used to create a new index variable, process outcomes.

Please indicate the extent to which you disagree or agree that the CFLRP collaborative process has...(select one for each option):

1. Enhanced communication among participants.
2. Minimized conflict among participants.
3. Enhanced decision-making (i.e., a more transparent, equitable, and fair process).
4. Included diverse perspectives.
5. Minimized litigation.
6. Enabled partners to plan at a landscape scale.
7. Enabled cross-boundary planning.

Appendix 7. Nested model comparison (χ^2(merge)) for all factor pairs (n=15) (Chapter 4)

Factor 1	Factor 2	χ^2	$\Delta\chi^2$	*df*	P-value
Principled Engagement	Shared Motivation	683.31	39.43	5	1.94E-07
Principled Engagement	Leadership	755.74	89.21	5	9.85E-18
Principled Engagement	Knowledge and Learning	683.61	53.72	5	2.39E-10
Principled Engagement	Resources	678.89	50.04	5	1.36E-09
Principled Engagement	Institutional Arrangements	781.80	93.37	5	1.32E-18
Shared Motivation	Leadership	888.92	153.44	5	2.47E-31
Shared Motivation	Knowledge and Learning	809.58	127.82	5	6.91E-26
Shared Motivation	Resources	762.47	110.46	5	3.27E-22
Shared Motivation	Institutional Arrangements	907.08	197.92	5	7.92E-41
Leadership	Knowledge and Learning	645.13	33.83	5	2.57E-06
Leadership	Resources	641.18	28.89	5	2.44E-05
Leadership	Institutional Arrangements	773.92	96.48	5	2.92E-19
Knowledge and Learning	Resources	627.62	20.35	5	1.07E-03
Knowledge and Learning	Institutional Arrangements	695.68	66.18	5	6.39E-13
Resources	Institutional Arrangements	690.37	54.42	5	1.72E-10