

Research Article - social sciences

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

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Abstract

Collaboration is increasingly emphasized as a tool to realize national-level policy goals in public lands management. Yet, collaborative governance regimes (CGRs) are nested within traditional bureaucracies and are affected by internal and external disruptions. The extent to which CGRs adapt and remain resilient to these disruptions remains under-explored. Here, we distill insights from an assessment of the Collaborative Forest Landscape Restoration Program (CFLRP) projects and other CGRs. We asked (1) how do CGRs adapt to disruptions? and (2) what barriers constrained CGR resilience? Our analysis is informed by a synthesis of the literature, case examples and exemplars from focus groups, and a national CFLRP survey. CGRs demonstrated the ability to mobilize social capital, learning, resources, and flexibility to respond to disruptions. Yet authority, accountability, and capacity complicated collaborative resilience. We conclude with policy and practice recommendations to cultivate collaborative resilience moving forward.

Study Implications: Collaborative approaches between public lands management agencies and nongovernment organizations have become common in forest restoration. Yet collaborative progress may be affected by turnover, wildfire disturbances, or legal or policy changes. We assessed how forest collaboratives in the United States adapted to changes that affected their performance and documented the factors that constrained response. We found that forest collaboratives developed myriad strategies to adapt to these changes, although limited authority, capacity, and accountability constrain adaptation options. We offer policy and practice recommendations to overcome these constraints, increase adaptation options, and enhance the sustainability of forest collaboratives.

Keywords: adaptive capacity, Collaborative Forest Landscape Restoration Program, collaborative governance, flexibility, resilience, resources, social capital, social learning

The USDA Forest Service increasingly uses 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 Forest Service-managed lands (Schultz et al. 2012). Projects were required to be developed and implemented collaboratively throughout planning, implementation, and monitoring (Butler and Schultz 2019a). The CFLRP was innovative in that it mandated collaboration and provided a mechanism for sustained funding (Schultz et al. 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 2019a). There is increasing evidence that collaborative approaches have supported restoration outcomes that approximate desired conditions (Cannon et al. 2018, Barrett et al. 2021); 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).

Although evidence of the benefits of collaboration in publicly managed forest 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 2019b). 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?

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 joined this review with examples from focus groups and a survey. We argue that whereas CGRs may demonstrate adaptability to myriad disruptions, there are persistent barriers that diminish CGR resilience.

Conceptual Framework

The conceptual model in [Figure 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 or internal CGR changes, including biophysical disturbances (e.g., wildfire), policy changes (e.g., funding), or legal challenges (e.g., litigation) can affect collaborative progress and performance, thus forcing CGRs to adapt (Ostrom 2009, Emerson et al. 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 (Smit and Wandel 2006, Nelson et al. 2007, Emerson and Gerlak 2014). Internal or external barriers can impede the adaptation process (Moser and Ekstrom 2010, Biesbroek et al. 2013). Adaptive capacities, actions, and barriers collectively determine whether desired outcomes are met and the extent to which CGRs are resilient (Turner et al. 2003, Emerson and Gerlak 2014; [Figure 1](#)).

To promote collaborative resilience to disruptions, CGRs must enhance their adaptive capacity (Walker et al. 2004, Folke et al. 2010). 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 Folke et al. 2005, Gupta et al. 2010, Hill 2013, Emerson and Gerlak 2014). 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, they include a diversity of interests, perspectives, and knowledge,

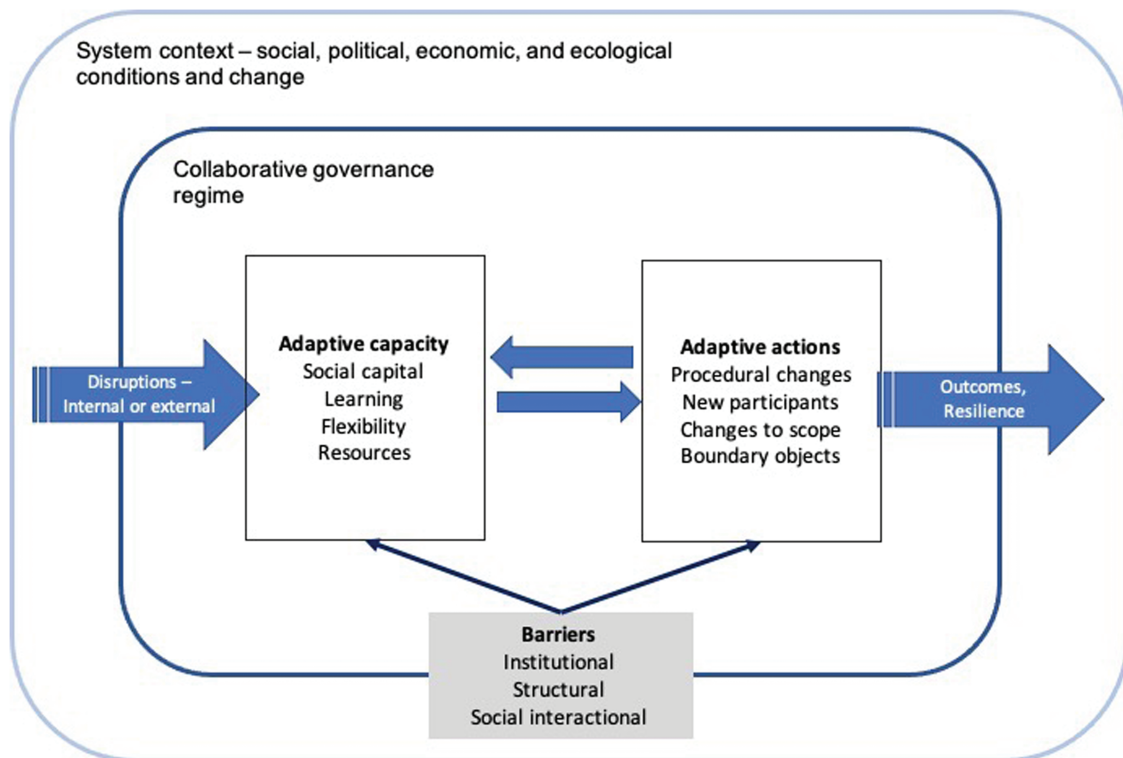


Figure 1. Conceptual model of the forces and factors that affect adaptation and resilience of collaborative governance regimes (CGR). CGRs are nested within the broader system context. Disruptions in the system context as well as internal disruptions can combine to expose collaboratives to potential 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.

and when formal and informal arrangements are connected within groups (bonding capital), across groups (bridging capital), and across levels of authority (linking capital) (Folke et al. 2005, Pelling and High 2005, Gupta et al. 2010). Robust social capital can promote resource exchange, flexibility, and social learning (Pahl-Wostl 2009, Engle and Lemos 2010, Koontz et al. 2015, Cinner et al. 2018, Sharma-Wallace et al. 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, or result in lost institutional knowledge or collaborative vision (Cheng et al. 2015, McIntyre and Schultz 2020, Coleman et al. 2021, Santo et al. 2021).

Learning is a key component of adaptive capacity (Folke et al. 2005, Berkes 2009, Pahl-Wostl 2009, 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 (Fernandez-Gimenez et al. 2008, Berkes 2009, Lebel et al. 2010). It emphasizes testing, monitoring, and reevaluating participants' held beliefs and understandings to coproduce knowledge of ecosystem dynamics, trends, and feedbacks to learn from and adapt to change (Folke et al. 2005, Lebel et al. 2010, Sharma-Wallace et al. 2018). Social learning can reduce conflicts and increase shared understanding, action, and trust (Fernandez-Gimenez et al. 2008, Lebel et al. 2010). 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 et al. 2015, Urgenson et al. 2017).

Adaptive CGRs have the flexibility to improvise and deploy alternative adaptation strategies (Engle and Lemos 2010, Gupta et al. 2010, Cinner et al. 2018). Multilevel social networks are thought to increase flexibility as diverse actors and organizations offer a

diversity of authority, capacity, and solutions (Folke et al. 2005, Gupta et al. 2010). Robust structures and processes for learning allow CGRs to experiment with novel solutions and flexibly respond to known and unknown disruptions (Folke et al. 2005, Gupta et al. 2010, Koontz et al. 2015, Cinner et al. 2018). 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, Eakin and Lemos 2006, Gupta et al. 2010, Emerson and Gerlak 2014). 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, 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 research organizations (Folke et al. 2005, Hahn et al. 2006, Berkes 2009, Cheng et al. 2015, Coleman et al. 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, or the development or revision of a charter or mission (Emerson and Gerlak 2014). Adaptive actions may also support capacity-building (Nelson et al. 2007, Hill and Engle 2015). For example, field trips and informal social interactions can enhance trust and social learning (Wondolleck and Yaffee 2000; Figure 1). Boundary objects can absorb the social capital and learning developed by CGRs (Cash et al. 2003, 2006, Feldman et al. 2006, Cheng et al. 2015). 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, Mollinga 2010, White et al. 2010, Cheng et al. 2015, Westerink et al. 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 (Wondolleck and Yaffee 2000, Moote and Becker 2003, Margerum 2007, Bierbaum et al. 2013, McNamara et al. 2020). 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, Moser and Ekstrom 2010, Gerlak and Heikkila 2011, Munaretto and Huitema 2012, Abrams et al. 2017) (Figure 1). CGRs are nested within and do not replace traditional bureaucratic institutions (Agranoff 2006, Kettl 2006). The Forest Service still retains decision-making authority over management actions, and thus can restrict the latitude for adaptation (Nie 2004, Abrams et al. 2017).

Methods

Data Collection

We addressed our research questions using a literature review and synthesis of the CFLRP literature on adaptability and barriers, 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 et al. 2016, Haddaway et al. 2016). Table 1 depicts the search sources, search terms or criteria used, and the number of retrieved documents for each phase. In phase 1, we reanalyzed a dataset the authors collected to support the Forest Service in their CFLRP results and lessons-learned summary series (Beeton et al. 2020). This included a review of peer-reviewed and grey literature from the CFLRP Resource Library¹ and an edited volume on collaborative governance dynamics in CFLRP projects (Butler and Schultz 2019a). 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 two hundred entries, a common practice in systematic reviews) (Haddaway et al. 2015). In sum, the initial search yielded 474 documents for screening.

The exclusion process is illustrated in Figure 2. We first removed duplicates, then 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 whether the document (1) focused on a CFLRP CGR and (2)

Table 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 CFLRP Resource Library under “general” and “collaboration” theme, excluding news release, presentations, webinars	43
	Butler and Schultz (eds.), 2019a		12
Phase 2	Chased		10
	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

CFLRP, Collaborative Forest Landscape Restoration Program

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;” and “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 (Supplement 1). A list of documents that were reviewed but ultimately excluded from analysis are included in Supplement 2.

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 (Supplement 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 subset of responses from the CFLRP Collaboration

Indicator Survey² administered by the National Forest Foundation in January 2020 to participants of the 23 CFLR projects (Figure 3), including collaborative participants and Forest Service staff. We analyzed responses to 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).

Data Analysis

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, 2011). Codes are derived inductively from analysis of data, as is the case with a grounded theory assessment, although the modified approach leaves room to situate the analysis within broader literature and theory (Mills et al. 2006, Thornberg 2012).

We derived a priori codes from the concepts introduced in the conceptual framework and Figure 1 (e.g., adaptive capacity determinants, adaptive

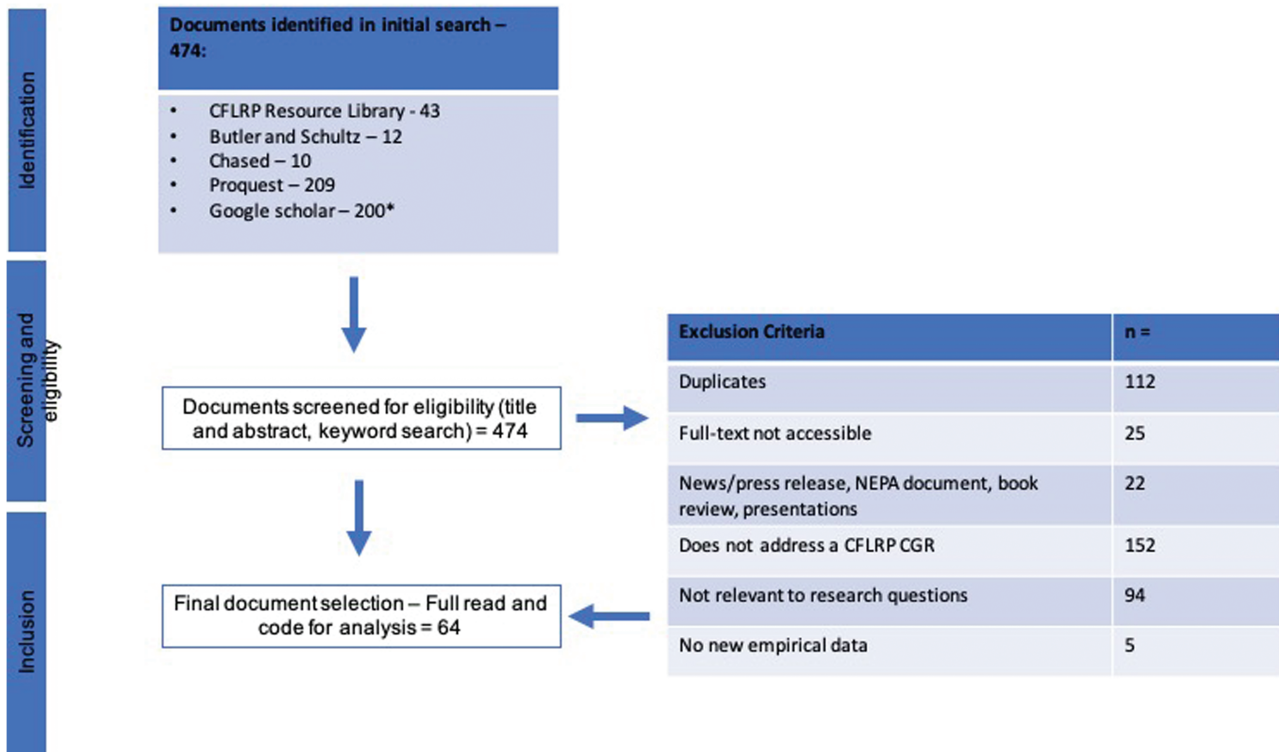


Figure 2. Literature review workflow including identification, screening and eligibility, exclusion, and inclusion. We searched multiple sources (CFLRP Resource Library, [Butler and Schultz 2019a](#) book chapters, Proquest, and Google Scholar). We reviewed the first 200 entries in Google Scholar, a 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. CFLRP, Collaborative Forest Landscape Restoration Program; CGR, collaborative governance regime; NEPA, National Environmental Policy Act.

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 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.

Results

Adaptations to Turnover

CGRs employed several strategies to adapt to turnover, including (1) codeveloping 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](#)).

Codeveloping Boundary Objects to Articulate

Collaborative Vision, Procedures, and Agreements

CGRs developed boundary objects, such as charters and memorandums of understanding or agreement, to articulate their collaborative vision, procedures, and expectations between collaborative members and among the Forest Service. Although 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 et al. 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.*³

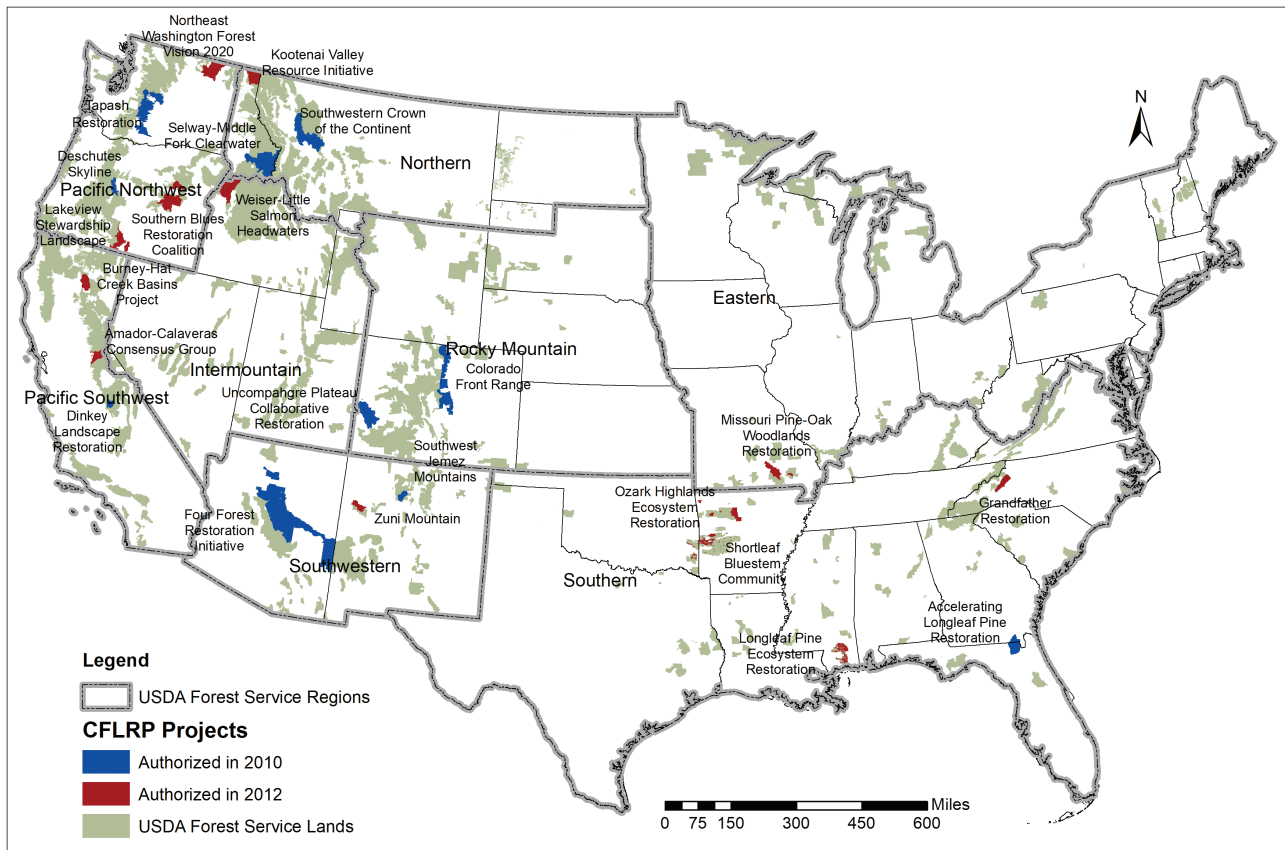


Figure 3. Map of Collaborative Forest Landscape Restoration Program projects. Ten projects were authorized in 2010 (blue) and 13 were authorized in 2012 (red).

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 than CGRs that did not (Coleman and Stern 2018, Stern and Coleman 2019). In some cases, hand-over memos were used to inform new personnel of expectations and commitments (Schultz et al. 2018, Butler and Schultz 2019b).

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 Restoration Coalition 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.⁴ 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 new personnel (Antuma et al. 2014, USDA Forest Service 2021).

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 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 mentoring procedures wherein outgoing members recruited and trained their

Table 2. Adaptation to turnover themes by frequency of occurrence, example responses, and key citations.

Response type	Frequency of occurrence	Example responses	Key citations
Codeveloping 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.	Antuma et al. 2014, Cheng et al. 2015, 2019, NFF 2016, Schultz et al. 2017, Butler and Schultz 2019b, Stern and Coleman 2019, USDA Forest Service 2021
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	Moote 2013, Antuma et al. 2014, Schultz et al. 2018, USFS 2018, Butler and Schultz 2019b, Cheng et al. 2019, Stern and Coleman 2019, Coleman et al. 2021, USDA Forest Service 2021
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

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 2018, 2021). 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, b Cheng et al. 2019).⁵

Spanning Levels of Agency Authority to Maintain Collaborative Philosophy

The decision to engage with CGRs is often up to individual personnel in the 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 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 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.⁶

Adaptations to Biophysical Disturbance

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 3).

Table 3. 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.	Larson et al. 2013, Tabor et al. 2014, Pile et al. 2019, Watts 2019, Wynecoop et al. 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.	

Flexible Institutions and Arrangements

CGRs demonstrated flexibility in responding to biophysical disturbances by altering treatment types, planning units, timelines, and 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. The group also identified a new planning unit and agreed on changes to CFLRP funding timelines, scheduling, and funding for reforestation (Spaeth 2014).

CGRs used innovative programs, authorities, and partnerships to address the increased scale of insect disturbance. CGRs in Colorado, Montana, and Washington used the CFLRP and the Joint Chiefs’ Landscape Restoration Partnership to fund landscape-scale restoration in areas affected by the mountain pine beetle epidemic (Abrams et al. 2021). Some groups used 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.*⁷

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.*⁸

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

Maintaining Agency Support for Restoration Goals

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

Table 4. 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
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; reorganized CGR structures to avoid FACA concerns.	Butler 2013, Tabor et al. 2014, Monroe and Butler et al. 2015, Walpole et al. 2017, Urgenson et al. 2017, Bothwell 2019
Collaborative learning	40	Codeveloped restoration principles and prescription guidelines; developed agreement around science and models.	Moote 2013, Monroe 2015, Vosick 2016, Christenson and Butler 2019
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.	Antuma et al. 2014, Spaeth 2014, Vosick 2016, Schultz et al. 2017, Bothwell 2019, McIntyre and Schultz 2020, USDA Forest Service 2021

*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.*⁹

Strong relationships with the Forest Service enabled CGRs to weigh in on postdisturbance proposed 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.¹⁰

Adaptations to Legal Challenges or Policy Change

CGRs adapted to legal challenges or policy changes through (1) flexible practices, processes, and operations; (2) collaborative learning; and (3) engaging objectors and intervening in court (Table 4).

Flexible Practices, Processes, and Operations

CGRs developed multilevel 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, and the Deschutes Skyline project developed a “super-collaborative” that linked two existing CGRs (Tabor et al. 2014, Monroe and Butler 2016).

Some groups were challenged on alleged Federal Advisory Committee Act (FACA) violations.

A collaborative group must be authorized as an FACA committee if a federal agency establishes and controls the group, it consists of nonfederal entities, and it provides collective advice to the federal agency (Butler 2013). Hence, CGRs adjusted how 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 Forest Service personnel from leadership positions to ensure compliance (Butler 2013, Monroe and Butler 2016).

CGRs invited participation from litigious parties and 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 didn'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 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].¹¹

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 (Bartlett 2012, Moote 2013). Subsequently, the group codeveloped 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 (Moote 2013, Butler et al. 2015, Christenson and Butler 2019). The marking guidelines were adopted by the Forest Service to inform silvicultural prescriptions and implementation decisions (Moote 2013). 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 for informing decisions has helped deter litigation in the Accelerating Long Leaf Pine Restoration CFLRP (Monroe 2015).

The Four Forests Restoration Initiative (4FRI) stakeholder group spent five years collaborating on the first 4FRI environmental impact statement (EIS). 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 to 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 predecisional objection process, those

were mitigated, and the record of decision was signed in 2015 (Vosick 2016).

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 Forest Service by submitting letters of support for projects, participating in the predecisional objection process, and intervening in court (Vosick 2016, Schultz et al. 2017, Bothwell 2019, McIntyre and Schultz 2020).¹²

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 (Schultz et al. 2017, McIntyre and Schultz 2020).¹³ 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 Forest Service.

Barriers

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

Agency Culture, Commitment, and Collaborative Incentives

The 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.¹⁴

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 (Cheng et al. 2019, USDA Forest Service 2021).

A lack of commitment to the collaborative process among decision-makers in the agency at unit and regional scales was also a significant barrier (Greer 2012, Bothwell 2019). The reviewed literature 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.¹⁵

Bergemann et al. (2019) found differences in line officer support for collaboration across 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 past collaborative engagement was variable following transitions. Although 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 et al. 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 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.¹⁶

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 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 2019b, Cheng et al. 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.¹⁷

In short, there are no formal mechanisms to hold the Forest Service accountable and committed to the collaborative process or inputs, which is exacerbated by turnover, especially because 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 (Greer 2012, Butler et al. 2015, Cheng et al. 2019, McIntyre 2019, Coleman et al. 2021).

Resource Constraints

Although 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 (Treadaway 2013, Schultz et al. 2018, Bothwell 2019). 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 (Mattor 2013, Treadaway 2013, Schultz et al. 2018), 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.¹⁸

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, Coleman et al. 2021, USDA Forest Service 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 (Egan and

Dubay 2013, Treadaway 2013, DuPraw 2014, Schultz et al. 2014, 2018, Butler et al. 2019, McIntyre 2019).

Discussion

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 situated our discussion within the 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, multiparty 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 codevelopment of, and interaction with, boundary objects helped CGRs translate this learning and social capital into codified expectations and responsibilities amid turnover (e.g., memorandums of understanding, charters). Documents (e.g., GTRs) and engagement with models (e.g., ecological condition model) 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.

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, Coleman et al. 2021, Santo et al. 2021). Yet CGRs have no formal authority to influence whether or when 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 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 renegotiate 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). Although 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 et al. 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-building 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 1997, 2000, 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.

Policy Recommendations

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.

Change in Agency Culture and Commitment to Collaboration

Ensuring that staff are dedicated to collaborative projects until completion, facilitating promote-in-place opportunities, and 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 2019b).

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 et al. 2015, Santo et al. 2020). Personnel shortages and budget constraints may hinder the ability of agency professionals to assess collaborative performance and integrate results into decision making (Wurtzbach et al. 2019), and internal performance measures may do little to improve agency accountability and responsiveness to CGRs (Schultz et al. 2015). Including external reviews from nonagency stakeholders involved in CGRs as part of forest unit performance evaluations could incentivize personnel to invest time and resources in collaboration (Cheng et al. 2019).

Practice Recommendations

Codevelop and Periodically Revisit Boundary Objects

Sustaining the codevelopment 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 et al. 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).

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 (Ulibarri et al. 2020, Salerno et al. 2021). Therefore, CGRs should routinely self-assess the disruptions to which they are exposed, and both short-term and long-term adaptations for collaborative resilience.

Conclusion

The Forest Service and policies like the CFLRP continue to encourage collaboration to advance wildfire risk reduction and forest restoration goals. Yet research on how 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.

Supplementary Material

Supplementary material is available at *Journal of Forestry* online.

Supplement 1. List of documents in literature review used for analysis.

Supplement 2. List of documents excluded from analysis.

Supplement 3. Collaborative resilience worksheet used for focus groups.

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Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Endnotes

- 1 <https://www.fs.fed.us/restoration/CFLRP/resource-library.php>
- 2 Results and raw data from survey can be found here—<https://www.nationalforests.org/assets/pdfs/Collaboration-Indicator-Survey-Results-2020-publish.pdf>
- 3 SWERI Cross-boundary workshop breakout group discussion.
- 4 Participant 22, NFF CFLRP Collaboration Indicator Survey
- 5 SWERI Cross-boundary workshop breakout group discussion; Participant 16, SWERI Cross-Boundary Workshop
- 6 Participant 53, NFF CFLRP Collaboration Indicator Survey
- 7 Participant 6, SWERI Cross-Boundary Meeting
- 8 Group 9, Idaho Forest Restoration Partnership Meeting
- 9 Participant 55, NFF CFLRP Collaboration Indicator Survey
- 10 Participant 6, NFF CFLRP Collaboration Indicator Survey; Participant 3, Idaho Forest Restoration Partnership
- 11 Participant 29, SWERI Cross-Boundary Workshop
- 12 Participant 9 and 27, NFF Collaboration Indicator Survey
- 13 Group 5, Idaho Forest Restoration Partnership Summit
- 14 Participant 9, NFF Collaboration Indicator Survey
- 15 Participant 18, NFF CFLRP Collaboration Indicator Survey.
- 16 Participant 9, NFF CFLRP Collaboration Indicator Survey.
- 17 Participant, 63, NFF Collaboration Indicator Survey
- 18 Breakout group 3, SWERI Cross-boundary Workshop

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