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policy

# Design and Governance of Multiparty Monitoring under the USDA Forest Service's Collaborative Forest Landscape Restoration Program

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Project-level monitoring is a necessary component of forest restoration and has historically been neglected. The 2009 Forest Landscape Restoration Act, which created the Collaborative Forest Landscape Restoration Program (CFLRP), authorizes funding for collaboratively designed restoration projects on US National Forests. It is the only statute requiring that the US Department of Agriculture Forest Service conduct project-level monitoring, specifically requiring collaboratively designed and implemented multiparty monitoring for 15 years after a CFLRP project begins. We conducted research to understand the design of these monitoring programs, their purposes, and their associated governance structures. Our goal was to investigate how this innovative aspect of the CFLRP is proceeding in the early years of the program and to set the stage for longitudinal research on this aspect of the CFLRP. We conducted and systematically analyzed semistructured interviews with 45 participants, including federal and nonfederal partners, from the first 10 CFLRP projects. We found that monitoring programs are being designed for a variety of purposes, such as tracking ecological impacts, maintaining trust with stakeholders, supporting "adaptive" planning documents meant to cover multiple years of treatment, and "telling the story" of these projects in terms of social and economic impacts to communities. Governance structures include formal roles and responsibilities for participants but lack formal processes for incorporating monitoring data into long-term project planning. Major challenges relate to the timing requirements of the CFLRP legislation, a lack of capacity among all parties in terms of time and expertise, navigation of the distinction between research and monitoring, and the design of adaptive planning documents to cover activities for multiple years over large landscapes.

**Keywords:** forest planning, monitoring, adaptive management, collaboration, restoration

Natural resource management literature has explored and highlighted the importance of monitoring and adaptive management (Ringold et al. 1996, Stankey et al. 2003, Stem et al. 2005). A consistent theme is that, despite the potential value of monitoring to promote learning, improve management, and diffuse conflict, it has been challenging to implement monitoring successfully, fund it consistently, and ensure that it happens in the political and legal context of US public lands management (Doremus 2008, DeLuca et al. 2010, Biber 2011, Schultz and Nie 2012).

In the context of forest restoration, monitoring is particularly important. Restoration is associated with numerous uncertainties and is highly complex, particularly in the context of a changing climate (Larson et al. 2013). Without adequate monitoring, the ability to understand the impacts of restoration activities on ecosystem integrity and sustainability is severely limited (DeLuca et al. 2010). Monitoring of forest restoration activities specifically at the project level is important for four reasons: (1) restoration is a process, and steps in the process should be evaluated; (2) restoration science is relatively new; (3) forest plans are increasingly predicated on the application of adaptive management, which requires monitoring to assess outcomes and adapt accordingly; and (4) restoration treatments may have negative impacts that can be mitigated before similar treatments are applied in the future or at broader scales (DeLuca et al. 2010).

In US forest policy, monitoring has been required in some form for decades,

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although almost exclusively at the plan and programmatic levels, rather than at the project level. The 1982 regulations promulgated by the US Department of Agriculture Forest Service (USFS) for implementing the National Forest Management Act of 1976 (NFMA) called for monitoring and evaluation to understand the impacts of required land and resource management plans (36 C.F.R. §219.11 [1982]). The regulations, known as the "planning rule," as revised in 2012, elevate the importance of monitoring. The new planning rule requires a three-part planning process that includes assessment, planning, and monitoring in an adaptive cycle, and includes eight specific monitoring requirements (77 FR 21162; 36 C.F.R. §219.19 [2012]). Monitoring also is required under the Stewardship Contracting Pilot Program. Although monitoring under the original 1999 Stewardship Contracting authority (PL 105-277) was to be done at the project level, in 2003 this requirement was changed to require programmatic monitoring only (PL 108-7). In addition, the USFS restricted the use of retained receipts under Stewardship Contracting to implementation monitoring only, thereby reducing both the funding and legal requirements for project-level effectiveness monitoring (DeLuca et al. 2010).

In 2009, Congress passed the Forest Landscape Restoration Act (FLRA) to fund implementation of collaboratively developed, landscape-scale restoration projects across priority forest landscapes on National Forest System lands. This act requires and authorizes funding for project-level, multiparty monitoring for collaborative forest restoration efforts (16 U.S.C. §7303). The FLRA established the Collaborative Forest Landscape Restoration Program (CFLRP), administered by the USFS, which selects projects for funding based on submitted proposals, with input from a federal advisory committee. For more details on the FLRA and its requirements, see Schultz et al. (2012).

The FLRA is unusual in that it requires competitive allocation of funding to projects that are expected to clearly demonstrate achieved outcomes. Another unique aspect of the legislation is the specific requirement that all projects use "a multiparty monitoring, evaluation, and accountability process to assess the positive or negative ecological, social, and economic effects of the project for not less than 15 years after project implementation commences" (16 U.S.C. §7303 [g][4]). A stated purpose of the FLRA is to encourage a process that demonstrates the degree to which restoration activities successfully achieve ecological objectives, reduce fire activity and management costs, and benefit local economies, while offsetting the costs to the agency of implementing treatments (16 U.S.C. §7301); thus, learning is central to the Act's purpose.

In a Senate hearing on the FLRA, Senator Jeff Bingaman (D-NM), who introduced the legislation and was chair of the Senate Energy and Natural Resources Committee when the Act was introduced and passed, emphasized why monitoring is important for CFLRP projects:

> [T]he whole idea behind this landscape-scale restoration, it's somewhat experimental, and we have put in this proposed legislation significant requirements for monitoring to learn what's working and what isn't working.... In the past, my understanding is that monitoring commitments on agency projects often have not been funded, and that's an area that seems to always get sort of short shrift (US Senate Committee on Energy and Natural Resources 2008, p. 15).

Appropriations under the FLRA may "be used to pay up to 50 percent of the cost of carrying out and monitoring ecological restoration treatments on National Forest System land for each proposal selected" (16 U.S.C. §7303[f][1]). In this way, the legislation gives the agency considerable discretion to decide how much money to allocate to monitoring and provides an opportunity for the USFS to commit to funding a long-term monitoring program, assuming the appropriation for the CFLRP continues from year to year.

The FLRA's requirement to develop, implement, and report on multiparty monitoring allows managers to allocate significant funding to monitoring. It also provides for consistent involvement from collaborative partners over the life of these 10-year projects. Therefore, the CFLRP has the potential to lead to significantly increased investment in and application of project-level monitoring on the program's selected forest restoration projects. The opportunity is set for managers and partners to better understand the impacts of restoration and also to discover successful strategies and key challenges associated with designing project-level monitoring strategies for forest restoration activities. Lessons learned could inform future efforts to monitor other forest restoration projects and also could inform the design of monitoring programs at larger scales.

This article reports on research we conducted on the monitoring strategies of the first 10 projects funded under the CFLRP (see Schultz et al. 2012 for details and Table 1 for information on the location and size of

## Management and Policy Implications

Monitoring the effects of forest management activities requires funding and expertise. Monitoring is a foundational aspect of three policies for managing National Forest System lands: administrative regulations for implementing the National Forest Management Act (also known as the "planning rule"), projects using Stewardship End-Result Contracting authorities, and the Collaborative Forest Landscape Restoration Program (CFLRP) projects. The CFLRP is unique among these in its requirements and funding mechanisms for project-level, multiparty monitoring. This makes the CFLRP an incubator and opportunity for managers and partners alike to experiment with and learn how to develop successful monitoring and adaptive management programs. The CFLRP monitoring programs are being designed in some cases to track ecological impacts, but in other cases, the emphasis is on building the social and political support necessary to implement long-term restoration programs. Thus, monitoring can be a useful tool for reducing uncertainty, involving stakeholders, building agreement around restoration approaches, and/or garnering political support by showing the value of restoration for local communities. Governance strategies of the CFLRP projects often do not include formal mechanisms for using the results of monitoring information to inform future rounds of planning; improved attention to using the results of monitoring to inform future project planning will make it more likely that adaptive management and learning take place. Land managers are navigating the important distinction between research and monitoring, by recognizing that monitoring, even when it is scientifically robust, ultimately is focused on the efficacy of specific treatments in light of project objectives. These multiparty monitoring efforts have faced challenges, such as limited time and expertise. At the same time, the CFLRP promotes the sharing of knowledge and responsibilities among agencies and other partners, making the program a possible venue for advancing the practices of monitoring and adaptive management for forest restoration.

**Table 1. Name, size, and location of the first 10 CFLRP projects.**

| Project name | Landscape characteristics | USFS administrative units involved |
|---|---|---|
| Selway-Middle Fork Clearwater Project | 1.4 million acres within the Selway and Middle Fork Clearwater River drainages in Idaho | USFS Northern Region (R1) Nez Perce, Clearwater, and Bitterroot National Forests |
| Southwestern Crown of the Continent | 1.45 million acres in Montana in the Southwestern Crown, a subregion of the International Crown of the Continent landscape | USFS Northern Region (R1) Lolo, Flathead, and Helena National Forests |
| Colorado Front Range Landscape Restoration Initiative | 800,000-acre lower montane restoration zone along Colorado's Front Range (part of a 1.5-million acre forest landscape) | USFS Rocky Mountain Region (R2) Arapaho, Roosevelt, Pike, and San Isabel National Forests |
| Uncompahgre Plateau Collaborative Restoration Project | 1 million acres of various of cover types along the western slope of Colorado | USFS Rocky Mountain Region (R2) Grand Mesa, Uncompahgre, and Gunnison National Forests |
| Four Forest Restoration Initiative | 2.4 million acres of contiguous Ponderosa pine forest across four National Forests in Northern Arizona | USFS Southwestern Region (R3) Apache-Sitgreaves, Coconino, Kaibab, and Tonto National Forests |
| Southwest Jemez Mountains | 210,000 acres in the Upper and Middle Jemez River watersheds of central New Mexico | USFS Southwestern Region (R3) Santa Fe National Forest and Valles Caldera National Preserve |
| Dinkey Landscape Restoration Project | 154,000 acres of coniferous forest, foothill hardwood and chaparral, and mountain meadows | USFS Pacific Southwest Region (R5) Sierra National Forest |
| Deschutes Collaborative Forest Project | 130,000 acres in the headwaters of two Upper Deschutes Basin Creeks (municipal watersheds) in Oregon | USFS Pacific Northwest Region (R6) Deschutes National Forest |
| Tapash Sustainable Forest Collaborative | 1,629,959 acres in central Washington's Kittitas and Yakima counties | USFS Pacific Northwest Region (R6) Okanogan-Wenatchee National Forest |
| Accelerating Longleaf Pine Restoration | 567,800 acres of largely longleaf and slash pine flatwoods in Northeast Florida | USFS Southern Region (R8) Osceola National Forest |

these projects). The research was designed to answer three questions: (1) What are the objectives of the CFLRP projects' monitoring strategies and what factors drive the choice of these objectives? (2) What are the governance arrangements for CFLRP monitoring programs; in other words, who chooses how much money goes toward monitoring, what is monitored, and who is responsible for collecting and interpreting data? and (3) What are the challenges these projects are facing in designing monitoring programs? Our goal was to use this opportunity to do research early in the policy implementation phase to understand current practices and challenges and set the stage for longitudinal research on monitoring approaches for CFLRP projects.

## Types of Monitoring and Implementation Challenges

Monitoring activities generally fall into several categories. One is implementation monitoring to check whether actions were performed as planned. Another is effectiveness monitoring to assess how implemented actions have affected various resources. Both types can quantify progress toward stated objectives; promote social learning; and increase trust, credibility, and accountability of resource managers to their peers, stakeholders, and the public (Doremus 2008, Fernandez-Gimenez et al. 2008). In the context of forest restoration, effectiveness monitoring can be used to increase knowledge of fire-adapted ecosystems; build understanding of which restoration treatments are most effective; minimize unwanted impacts on other resources; and make necessary adjustments in the face of a wide variety of current and projected future circumstances, including changes in climate, demographics, and local and global economic conditions (DeLuca et al. 2010, Larson et al. 2013). Validation is a third type of monitoring. It is used to ascertain whether observed effects are the results of management activity, rather than some aspect of natural variation in a system or random chance (Larson et al. 2013).

The ultimate objective of monitoring is often conducting adaptive management, which is the systematic and iterative collection of monitoring data and subsequent evaluation of that data to improve decision-making (Holling 1978, Moir and Block 2001). Adaptive management has been identified as a critical process for promoting social and ecological resilience (Folke et al. 2005). It can be understood as a management paradigm that provides a framework to reduce scientific uncertainty, improve effectiveness and cost-efficiency, and increase confidence in management decisions over time (Schultz 2008, Biber 2011).

Monitoring and adaptive management are costly and time-consuming and require expertise (DeLuca et al. 2010). The two are also difficult for federal agencies to commit to, fund, and implement (Ruhl 2008, Benson 2010, Doremus 2011). Because the results from monitoring often do not materialize quickly, there are minimal short-term incentives for decisionmakers or politicians to invest in monitoring (Doremus 2008, Biber 2011). Agencies frequently lack the capacity to manage the considerable data collection, storage, interpretation, and synthesis demands of an effective monitoring and adaptive management program (Doremus 2008). Agencies also may have disincentives to monitor when the resulting information might show negative impacts of management actions (Doremus 2011).

For similar reasons, the formal elements of adaptive management, including the use of conceptual models, experimental design, triggers for changing management actions, and strategies for incorporating findings into future management decisions, are rarely used by federal agencies (Ruhl and Fischman 2010, Schultz and Nie 2012). An exceptional example of active adaptive management is the CFLRP Southwestern Crown of the Continent project (Larson et al. 2013). Agencies may adopt some aspects of adaptive management but either fail to build in the scientific rigor that holds the most promise for reducing uncertainty or fail to establish predefined feedback loops that might require future management changes (Doremus 2001, Nie and Schultz 2012). This may happen unintentionally due to funding uncertainties in future years or out of a reluctance to constrain decision-making in the future. Researchers have also found institutional barriers to adaptive management, such as prohibitions on experimentation or research, lack of training, and

risk aversion in the face of legal standards and the threat of litigation (Stankey et al. 2003, Doremus 2008).

Managers face several other challenges to monitoring that are rooted in administrative and constitutional law. For instance, in the context of US administrative law, even when an agency commits in a planning document to long-term monitoring, it can be extremely difficult to enforce in the legal system. As Biber (2011) explained, courts are reluctant to enforce monitoring commitments because monitoring is not considered a final agency action that is reviewable under the Administrative Procedures Act of 1946. Moreover, even when courts enforce monitoring commitments, as long as some compliance exists, judges generally will not review the quality of a monitoring program. Limited enforceability makes it more likely that monitoring will be underemphasized over time, because of limited funding, a lack of leadership, or the relatively greater importance of other activities. Funding monitoring is also a challenge. Under the US Constitution, Congress decides how public money will be spent and provides money to federal agencies through annual appropriations bills, with funding attached to specific budget line items restricting how these dollars can be spent (Rasband et al. 2009). Therefore, if an agency such as the USFS wants to spend money on monitoring, Congress must appropriate those dollars to a line item that allows funds to be spent on the desired monitoring activities. In addition, the Anti-Deficiency Act of 1905 prevents agencies from spending funds from the current fiscal year in future fiscal years, unless they have been specifically permitted to do so. For these reasons, multiyear monitoring programs can be difficult to commit to because they depend on annual appropriations from Congress that may be inconsistent. However, as discussed earlier, given the nature of the CFLRP appropriation and the consistent involvement of partners in CFLRP projects, these issues are likely to be less significant barriers to monitoring under this program.

Multiparty monitoring involves stakeholders and agencies working together to design, fund, implement, and oversee monitoring programs. It offers a partial solution to the problems of cost and accountability. It also can be an effective way to engage stakeholders in the process of determining monitoring priorities, deciding where trigger points should be set and what management changes should occur when those points are reached, and ensuring that a high-quality monitoring and adaptive management program is put in place and implemented over time (Fernandez-Gimenez et al. 2008, Nie and Schultz 2012). Partners also may be able to share the costs of a monitoring program with the agency, secure grants that otherwise would not be available to the USFS, and advocate for the importance of monitoring with decisionmakers and appropriators. However, at the same time that multiparty monitoring may increase social capital, trust, and stakeholder involvement, it may also lack the rigor needed to produce learning and reduce uncertainty if it is not implemented consistently and according to strict protocols. As DeLuca et al. (2010) noted, agencies bear the ultimate responsibility for ensuring that data collection, interpretation, and storage are high-quality, reliable, and meaningful, based on the purposes for which they were designed. Therefore, although the USFS may welcome the expertise, capacity, and involvement of partners in designing and implementing monitoring programs, staff may have apprehensions about the extent to which they want to or can share responsibility with collaborative partners. These are compounded by the fact that agencies cannot abdicate decisionmaking authority to a collaborative group without potentially running afoul of legal mandates (Butler 2013). In these ways, the CFLRP requirement for multiparty monitoring presents a suite of opportunities and challenges to navigate.

## Methods

This research used a qualitative and comparative case study approach (see Schrader-Frechette and McCoy 1994, Yin 2009). Each of the first 10 CFLRP projects was treated as an individual case. Summary details on these projects are in found in Table 1; for more information on their history and collaborative structure, see Schultz et al. (2012) and Butler (2013). Although each case is unique based on its geographic location, biophysical attributes, agency personnel, and collaborative structure, comparisons and themes can be drawn from across these cases because they have several factors in common: they are operating under a single legislative authority, have similar institutional contexts, and share the primary purpose of achieving forest restoration. The first 10 projects were funded under the CFLRP in 2010, and 13 additional projects were selected for funding in 2012. We chose to research the first 10 projects based on the assumption that they would be further along in development of their monitoring strategies than the newer projects.

Our methods are nested in a pragmatic worldview, meaning they are designed to investigate a topic of practical value to practitioners and are informed by past research. For this type of research, mixed and qualitative methods are often appropriate for investigating questions of interest with multiple types of data (Creswell 2008). Stankey et al. (2003) used this approach for research on Northwest Forest Plan implementation, and Butler (2013) used it for research on the collaborative aspects of CFLRP projects. Our methods included a content review of documents such as the monitoring sections of the projects' CFLRP proposals, their written monitoring plans, and other available documents relevant to monitoring, such as meeting notes. We also conducted semistructured interviews using an interview guide, a predetermined set of questions. A semistructured format allows for the exploration of topics as they arise, allowing interviewees the flexibility to emphasize what they feel is most important (Charmaz 1991). Initial questions focused on the development of the monitoring program: how, for what purposes, and by whom it was developed; how it will be funded; and what are the major challenges or constraints encountered in the process. A second set of interview questions revolved around issues involving the collection and interpretation of data: who is responsible for data collection and when, whether adaptive management is a goal and how it will be accomplished, and who will be involved in reviewing data and deciding how to incorporate findings into future project design. Then we asked several additional questions to understand the roles and responsibilities of various partners and USFS staff in the process of designing and implementing the monitoring programs. A total of 45 interviews were conducted, with a range of 4–7 interviewees for all projects except two (the Accelerating Longleaf Pine Restoration and Tapash Sustainable Forest Collaborative projects), for which we were unable to complete full case studies because either interviewees or monitoring documents were not available at the time of the research. Interviews took place between June 2012 and June 2013. Initially, we contacted individuals directly involved in the design of the monitoring program,

including both USFS personnel and external stakeholders; this is known as purposive sampling (Singleton and Straits 2009). We then used snowball sampling, which relies on suggestions from the original list of interviewees about who else should be interviewed (Singleton and Straits 2009).

We recorded and transcribed all interviews to which we then applied an open-coding methodology. This was based on a grounded theory approach, whereby findings are inductively based on or "grounded" in the data (Strauss and Corbin 1990, Creswell 2008). Coding is a systematic method of reviewing interview transcripts. It allows the researcher to identify themes in interview data in an iterative and systematic fashion. Initial codes are generally closely linked to research questions, and additional codes are created during the data analysis process to inductively identify key themes and findings across interviews. For each case study, we wrote a comprehensive summary of all of the key findings for that case, including important quotations and themes. These summaries served as the basis for writing our Results section, which provides an overview of our findings across the case studies.

## Results

Findings presented in this section are organized according to our three primary research questions: factors that are driving the design of monitoring programs, governance frameworks, and major challenges and opportunities identified by interviewees. In each subsection we explain the variation in responses and approaches across projects and also identify consistent themes that arose over the course of the research.

### Factors Driving the Design of Monitoring Strategies

All projects have some social, economic, and ecological monitoring objectives, based on the requirements of the FLRA. In addition, all projects are required to report on five different ecological, social, and economic national indicators for 5-year reports to Congress. These national indicators are standardized to provide a common set of metrics across CFLRP projects, but also allow individual projects to tailor the indicators to match their project objectives (for more detail, see Sidebar 1). Beyond these requirements, monitoring frameworks under CFLRP are being designed for a wide variety of purposes. We discuss examples of these below and provide a summary of the primary monitoring objectives for each project in Table 2.

All of the projects have some emphasis on understanding the ecological impacts of project implementation, and for some of the CFLRP projects, this is the central focus of their monitoring efforts. For example, the design of monitoring on the CFLRP Dinkey Landscape Restoration Project is focused foremost on ecological impacts, with a particular emphasis on at-risk species, although the group has also recently entered into a contract with a third party to design and implement socioeconomic monitoring. As one collaborative group member explained:

> Our monitoring work is driven by a desire to learn more about how forest restoration impacts a variety of different resources. . . but more specifically how those forest restoration treatments will affect key species that are currently on the edge of viability.... There's not a lot of opportunity for error with the Pacific fisher [*Martes pennanti*] and the spotted owl [*Strix occidentalis occidentalis*].

As another example, monitoring within the Colorado Front Range Landscape Restoration Initiative is being designed to improve understanding of historic, current, and desired ecosystem conditions. A subgroup of the project's science and monitor-

### Sidebar 1. CFLRP Reporting Requirements and National Indicators.

All CFLRP funded projects have annual and 5-year reporting requirements.

- *Annual reporting* includes (1) a description of areas treated/restored, (2) an evaluation of project performance and progress, (3) a description of community benefits achieved, (4) the results of multiparty monitoring, (5) a summary of the costs of treatments, and (6) relevant fire management activities accomplished.
- *Five-year reporting* is intended to demonstrate to Congress the extent to which the program is fulfilling the purposes of its enabling legislation (FLRA) and includes metrics, or *national indicators,* on collaboration, leveraged funds, fire costs, ecology, and jobs/economic impacts. The first report to Congress will be prepared in FY2014.

#### National Indicators

In June 2011, program partners and agency staff developed the suite of national indicators to supply information in the 5-year report to Congress. The goal of these indicators is to maintain the ability to evaluate each CFLRP project on its own objectives, while also providing a common set of metrics that tier directly to the Act.

Of the national indicators, the leveraged funds and job/economic impacts indicators have been incorporated into annual reporting as of FY2012. The Treatments for Restoration Economic Analysis Tool (TREAT) is being used to estimate the number of jobs and labor income generated by CFLRP project activities. Fire costs are estimated using the Forest Service Risk and Cost Analysis Tools Package (R-CAT) model. Groups are pursuing performance measures of collaboration independently.

#### National Ecological Indicator

The ecological indicator is perhaps the most complex of the suite of national indicators because it must reflect the relevant restoration objectives and activities for each landscape, but also allow for communication of accomplishments across the entire CFLRP program for all projects. Each CFLRP project has developed or is developing a set of metrics and desired conditions to evaluate progress across the four ecological categories identified within the Forest Landscape Restoration Act: (1) fire regime restoration; (2) fish and wildlife habitat condition; (3) watershed condition; and (4) invasive species severity. Funds from the National Forest Foundation have supported CFLRP projects across the country in identifying their project-specific desired conditions and reporting on national indicators (Karen DiBari, National Forest Foundation, pers. comm., Jan. 15, 2014).

Progress toward desired conditions is evaluated as good, fair, or poor based on a standardized scoring system that identifies what proportion of the landscape has moved toward desired conditions and what percentage of implemented treatments have resulted in measurable progress toward project-level objectives. This system was designed to indicate progress at both the landscape and the project scale. Each CFRLP project has some flexibility to determine the total area that should be treated over the 10-year project funding cycle and also determines the desired conditions that will be measured in each category.

**Table 2. Key factors driving the design of monitoring programs.**

| CFLRP project | Key monitoring objectives highlighted in interviews |
|---|---|
| R1: Selway-Middle Fork Clearwater Project (ID) | Evaluating the success of socioeconomic outcomes such as job creation, economic growth in rural communities, and a strong local timber industry; effectiveness monitoring to determine the progress of restoration treatments; utilizing citizen-science and multiparty monitoring to increase trust and communication among stakeholders |
| R1: Southwestern Crown of the Continent (MT) | Determining treatment effectiveness; understanding socioeconomic effects; building stakeholder trust and engagement; building the scientific and sociopolitical case for restoration in an area with a history of litigation |
| R2: Colorado Front Range Landscape Restoration Initiative (CO) | Refining desired conditions and restoration treatments to create desired spatial heterogeneity at multiple scales; engaging partners and building trust; supporting adaptive management |
| R2: Uncompahgre Plateau Collaborative Restoration Project (CO) | Sustaining and building community and stakeholder engagement and trust; understanding treatment effectiveness; supporting larger scale and more flexible project decisions; understanding landscape interactions |
| R3: Four Forest Restoration Initiative (AZ) | Understanding ecological, social, and economic impacts; ensuring compliance and consistency with the NEPA document over 10+ years of implementation; maintaining trust among stakeholders; coordinating data across broad scales; adapting treatments over time |
| R3: Southwest Jemez Mountains (NM) | Understanding ecological impacts; ensuring the project accomplishes the goals of the FLRA; involving partners over the course of implementation |
| R5: Dinkey Landscape Restoration Project (CA) | Understanding ecological impacts, particularly to at-risk species; building stakeholder support for project implementation; adapting the design of treatments over time |
| R6: Deschutes Collaborative Forest Project (OR) | Collecting socioeconomic data to support the CFLRP; improving understanding of the effects of collaboration and adaptive management; conducting multiparty field reviews to assess implementation from stakeholder perspectives |
| R6: Tapash Sustainable Forest Collaborative (WA) | Meeting the objectives of the Act, but monitoring plan was still under development at the time of this research |
| R8: Accelerating Longleaf Pine Restoration (FL) | Gathering data to feed into a recently developed ecological condition model, which, when tracked over time, will indicate the efficacy of different treatments |

ing team has developed a protocol for tracking the effects of restoration treatments on wildlife, intrastand structural heterogeneity, and understory vegetation.

Another important and related monitoring objective for projects is ensuring that project implementation will take place as planned and that effects will be within predicted ranges. For several projects, this is particularly critical for maintaining the "social license" to proceed with restoration, especially on projects that are planning and writing National Environmental Policy Act of 1969 (NEPA) documents at unusually large scales. For instance, the Four Forest Restoration Initiative (4FRI) is completing a NEPA document for an area covering multiple ranger districts and more than 750,000 acres. Such an unusually large project-level NEPA document raises questions as to whether activities will be implemented as planned and whether the effects, especially over the landscape scale, will be within predicted ranges. A USFS interdisciplinary team member explained, with regard to monitoring,

> [T]he sociopolitical ramifications are extremely important, and maybe even more important than the actual monitoring data that we get. ...[I]t's the fact that we will be doing monitoring, and we will be hopefully doing the adaptive management that...may give us that social license to move forward.

One of the 4FRI stakeholders echoed this, stating:

> I think the lack of trust is heightened because of the size of the NEPA and the fear that once you have a signed document, if we see [unexpected] changes, we won't have the flexibility to mandate...a change.

Interviewees from both of the Colorado CFLRP projects also indicated that monitoring is central to supporting relatively large planning documents and ensuring that effects will be within predicted ranges over time.

The large scale of analysis for some documents is also leading to increased emphasis on standardizing and coordinating data over time. For instance, NEPA analysis is occurring at larger spatial scales on the CFLRP Uncompahgre Plateau Collaborative Restoration Project, with projects increasing in size from a few thousand acres to more than 140,000 acres for the recently planned Escalante Forest Restoration and Stewardship subproject. The spatial and temporal scale of these projects, according to interviewees, affects the nature of the monitoring program, which interviewees said was designed so that data are consistent and can be used to inform management changes over many years of treatment and over large scales. One USFS employee stated:

> It's going to be a multiyear thing and a multicontract thing. We want to have a monitoring effort that is consistent across the projects and can use the results of one contract in one area to feed into efforts in another area.

Interviewees from the CFLRP Deschutes Collaborative Forest Project and Selway-Middle Fork Clearwater project emphasized the importance of socioeconomic monitoring to tell the CFLRP story. As one interviewee from the Selway-Middle Fork project explained: "At least right now, we're trying to focus on the socioeconomic side...we think that's where we need information the most.... It's something that the local public is more concerned with." Participants on both of these projects stressed the importance of communicating to appropriators and the public the effects of the CFLRP: "The idea is being able to demonstrate where their money is going, why we are a good investment."

Finally, on some projects, one of the primary purposes of monitoring is engaging stakeholders. On the Southwest Jemez Mountains project, USFS staff said that monitoring is a key part of implementation for which stakeholders can directly participate in the field. Similarly, monitoring on the Uncompahgre Plateau project is driven largely by stakeholder interests and engagement. The project has a historical emphasis on what USFS staff characterize as "citizen science" and "field-based learning." According to both USFS and external interviewees, this history of stakeholder involvement in monitoring has contributed to high levels of trust and a shared understanding of desired conditions among stakeholders and the USFS.

## Governance Frameworks

Governance arrangements for most projects often include formal roles for participants with regard to designing the monitoring programs, but a less formal process

for implementing monitoring programs and interpreting data. For instance, coordination of the Colorado Front Range monitoring effort is overseen by a monitoring committee and issue-specific subcommittees, with much of the data collection being done by the Colorado Forest Restoration Institute at Colorado State University. However, the details of the monitoring plan are still being developed, as was true for most of the CFLRP projects as of 2013. Members of the collaborative group agreed that there is a shared monitoring plan, but most described it as a work in progress. As one stakeholder noted, "[We are] conducting some monitoring and figuring out how to revise the monitoring plan.... The whole effort has been a little bit nonlinear and complicated." There are benefits to this "learning by doing" approach and to having a "living document," but some also shared a sense of frustration over the lack of consensus on clear desired conditions that would drive a more robust and effective approach to monitoring.

Likewise, on the Dinkey project, the collaborative has a monitoring working group and a monitoring coordinator funded jointly by the USFS and The Wilderness Society. This person refines the monitoring plan, which is still a work in progress, coordinates data collection and interpretation, and presents this information semiannually to the collaborative. In addition, this job includes translating the monitoring questions from the plan into specific monitoring activities, which occur under five overarching monitoring categories: fire and fuel dynamics, biodiversity, soil and water effects, economic impacts, and social implications. The monitoring working group also has a process to further develop its monitoring matrix, which, for a suite of monitoring objectives, includes questions, indicators, desired conditions, triggers, data collections methods, cost estimates, and frequency and timing of monitoring activities. Prioritization of monitoring questions also occurs according to seven criteria: multiple benefits (usefulness for more than one resource), comprehensiveness (filling of an information gap), cost, linkage to CFLRP objectives, sensitivity of the resource, adaptive management potential, and responsiveness to treatments. Interviewees indicated that the monitoring plan, as of early 2013, has not been finally approved by the full collaborative and that the final determination of monitoring priorities for individual projects is an ongoing process that is undertaken by the full collaborative as the details of funding and individual projects become available. Like other CFLRP projects, the Dinkey project has no formal process for incorporating monitoring information into future projects.

The Longleaf Pine Restoration project took the unique governance approach of allocating 5 years' worth of monitoring funding from the initial year's appropriation into an agreement with an external contractor, Tall Timbers Research Station. A USFS representative explained, "[T]hat allowed a lot of freedom and a lot of flexibility...basically what it did is it solidified a five-year program of monitoring." This representative further explained, "When we were doing the proposal...we said, if we get this, we need to be ready to implement and have a monitoring plan and monitoring protocols established...so that if we [a]re awarded, then we [are] ready to rock and roll and get our baseline data." This approach and the "open collaborative structure" of the project, which has no formalized decisionmaking process, make this project different from other collaboratives that have spent considerable time deliberating over their monitoring priorities and protocols. One Longleaf interviewee elaborated on their ability to hit the ground running, stating,

> Our public is different and our location is different.... [W]e had folks collaborate on the proposal but once everybody was pretty much thumbs up with what Tall Timbers proposed, it was just implementation from then on out.

The Selway-Middle Fork Clearwater Project also made the decision eventually to contract much of the initial monitoring to an environmental consulting company in 2012. This contractor is collecting and analyzing data on baseline conditions and making recommendations for future monitoring investments.

Funding for monitoring is at about 10% of CFLRP dollars for most projects, although this is generally not a firm commitment. On the Jemez project, the USFS has agreed to devote about 9% of CFLRP dollars to monitoring. The agency is working to keep this money devoted entirely to effectiveness monitoring, viewing implementation monitoring as a required aspect of project implementation to be covered using other funding sources. Similarly, the Southwestern Crown project devotes roughly 10% of project funds to effectiveness monitoring. However, the Deschutes project, a project emphasizing implementation more than monitoring, only devotes enough funding each year to report on the required national indicators. The Colorado Front Range CFLRP has not dedicated a set percentage of funds to monitoring, but has invested both CFLRP and regular program dollars to monitoring and has solicited external funding from the Department of the Interior through the Southern Rockies Landscape Conservation Cooperative.

## Challenges in Designing Multiparty Monitoring Strategies

Challenges for these projects relate to the timing and requirements of the CFLRP, the capacity to undertake the necessary work, and definition of the scope and design of a monitoring program. One major challenge is navigating the distinction between research and monitoring. The McSweeney-McNary Act of 1928 requires the separation of Forest Service research and administration; therefore, the National Forest System is not supposed to fund research.[1] To help staff navigate this issue, the CFLRP website states:

> CFLRP funding can be used to fund implementation and effectiveness monitoring of proposed restoration treatments. CFLRP funding cannot be used for research or monitoring beyond the CFLRP project (for example, Forest Plan monitoring). Monitoring with CFLRP funds is limited to assessing whether the project was implemented to the specifications and assessing the direct effects of the restoration treatment(s).[2]

Nonetheless, there is no clear line distinguishing monitoring from research. This is causing confusion and concern for many CFLRP participants, particularly within the USFS, who want to ensure they are using funds appropriately. For instance, one USFS interviewee, when asked if his or her project was using any controls in conjunction with monitoring said, "No, because it's not a research project." Another USFS participant, when asked about wildlife population monitoring, said, "That seems more research related, but it might be tied to adaptive management. I'm not sure." Another USFS participant began to disentangle this issue, explaining:

> We were trying to be careful about not doing scientific research, but you get into a semantic issue here, because if you really do science-based adaptive management, science by definition is a philosophy of thinking and for approaching a problem that involves hypotheses, questions about these things, and then organizing your observations in a fashion that...can test those ques-

> tions. So that means you have controls, untreated areas.... So in that regard it's very difficult to distinguish between research and monitoring.

A stakeholder, who is both a scientist and manager working with one of the CFLRP groups, observed that, in the case of most restoration efforts, "the more scientific rigor that you can bring on the front end to what you decided you are going to monitor, the better off you are." Our understanding from these findings is that monitoring may look like research, because it is often designed to be scientifically valid. If this monitoring is designed to assess the impacts of restoration treatments done under the CFLRP and not to answer questions that are broader in scope, then the monitoring activities, even if they are scientific, are being done in accordance with the agency's guidance under the CFLRP.

Timing is another challenge that these projects are facing and is to some extent an artifact of the CFLRP legislation and federal budget cycles. The FLRA requires that dollars be used to implement projects in the same year that the money is allocated. However, in the first years of funding, many of these projects, although they had some history of collaboration and a vision for landscape-scale restoration, had not completed a NEPA document to meet the goals of the CFLRP. One stakeholder noted that, to have a clear sense of treatment objectives, it would be ideal to have a draft NEPA document done before the development of a monitoring strategy, thus supporting the development of a monitoring plan that could be closely linked to planned activities and predicted effects. In general, the requirement to implement projects immediately means that some groups are "now having to do the work that we ideally should have done before our proposal was submitted—like getting the monitoring plan well fleshed-out before we launched." Timing of funding allocations can also present challenges. One USFS planner indicated that it was only in the third year of the CFLRP that the forest got their funding early enough in the fiscal year to plan collaboratively how to use it. The collaborative nature of the CFLRP has also slowed progress in developing and implementing monitoring plans. Collaboration, one stakeholder pointed out, is "slow and clunky.... We're just learning how to operate collaboratively together, and it's painful." One further timing issue relevant to several projects is the development of the national indicator requirements for all CFLRP projects (discussed above). One USFS employee from the Uncompahgre Plateau project, when discussing the issue of having to adapt the project's monitoring protocols to match the national indicators, voiced a concern about having to "re-talk about some things where we had great buy-in locally." Participants from each of the groups worked together to develop a framework for the national indicators that could be tailored to the individual goals of each project to the greatest extent possible. Nonetheless, we were told that delays in developing these requirements posed a challenge on projects such as the Deschutes and Longleaf Pine Restoration, for which monitoring programs were shaped largely by the national indicator requirements. On these projects, stakeholders are generally more interested in implementing the maximum possible number of acres of treatments than in collecting new data. As the CFLRP continues, timing challenges will probably become less significant.

Capacity has also been a challenge, both in terms of time and expertise. The development of monitoring plans has proceeded slowly in many cases because, as one external monitoring group lead explained, "all of the people to a large extent...are volunteers, including myself.... With [our USFS contact], he also has a full-time job with the USFS, so he can only devote so much time to this." Some collaborators noted that not many USFS staff are trained to collect data with a high level of statistical certainty and sometimes are concerned that the level of monitoring stakeholders envision is beyond their capacity to conduct or outside of their job responsibilities.

Each group is developing a unique approach to adaptive management, but most are pursuing informal learning by doing. For example, the Uncompahgre Plateau and Deschutes projects are adapting stand-level prescriptions based on field tours with stakeholders and their perceptions of the effectiveness or suitability of treatments. As one participant explained, "Our goal is not just to review a project and to evaluate the performance there, but to provide learning that will reform future activity." The Colorado Front Range project is developing a framework to guide the use of implementation and effectiveness monitoring information at different points in the planning and implementation process. Depending on the questions asked, monitoring results could inform site-specific prescriptions, NEPA planning, or larger questions of desired conditions and project objectives. For this CFLRP project, a key challenge is to construct a NEPA document that can respond to monitoring information and allow for alternative management approaches within a single decision. As one stakeholder stated:

> [W]e're struggling with the notion of adaptive NEPA. How do you write a NEPA document that accommodates the kind of change that you intend to implement as a result of monitoring? How do you write those [desired future conditions]...so they're sufficiently detailed to meet the NEPA requirements and inform the public of your intentions but don't box you into a situation where you've got to reenter a NEPA process every time you want to make a change?

On the Dinkey project, participants said they are finding it easier to pursue adaptation by conducting smaller decisions and adapting management between projects rather than within larger individual NEPA decisions. Another interesting case with respect to adaptive management is that of the Southwestern Crown project, which is undertaking active adaptive management under NEPA with its Dalton Mountain subproject, using an experimental design to test effectiveness of treatments against an untreated control site (Larson et al. 2013).

## Discussion

Multiparty monitoring has the potential to be a valuable component of landscape-scale restoration and the CFLRP. Groups have designed their strategies with the intention of promoting knowledge generation and learning, maintaining or promoting accountability and trust among stakeholders, reducing uncertainty regarding landscape-scale and long-term effects of restoration, and supporting the development of adaptive management frameworks that facilitate changes in project planning and implementation in response to monitoring information. Beyond this, developing monitoring collaboratively may turn out to have broader impacts, such as stimulating capacity sharing and learning across organizations and providing a space in which the USFS and stakeholders can experiment with designing larger projects covered by a single NEPA document that allows for adaptation over time. Our findings suggest that CFLRP may serve as an incubator not only for developing effective approaches to multiparty monitoring but also for improving long-

term project collaboration and experimentation with large-scale restoration.

Interviewees also told us that the CFLRP was elevating, more generally, the importance of monitoring in project planning and implementation. Stakeholders often indicated that the provisions in the FLRA gave them the opening to engage the USFS in a discussion about monitoring, and individuals within the USFS stated that the CFLRP creates the space and incentives internally to put increased emphasis on monitoring. One USFS interdisciplinary team leader noted the high profile of the CFLRP project on their forest, the requirements of the FLRA, and active engagement from a stakeholder group all work together to increase attention on monitoring. Designing effective monitoring, noted several USFS planners on multiple CFLRP projects, is also informing how forest plan monitoring will take place under the new planning rule. In some cases, planners indicated that CFLRP monitoring data will support plan revision. In this way, the CFLRP could be a key piece of a larger shift within the agency toward increasing the amount of resources devoted to landscape-scale monitoring, if this remains a key focus under the planning rule as it is implemented.

The CFLRP projects are well positioned to undertake adaptive management, given the 10-year cycle of subprojects, which are to be implemented with consistent participation from a stakeholder group and a consistent set of restoration objectives. In our view, to inform future adaptive management efforts, it would be valuable for future researchers to collect lessons learned about adaptive management approaches undertaken by the CFLRP projects, specifically looking at how to sync adaptive management with planning under NEPA. Such lessons would benefit efforts to implement adaptive management under the 2012 USFS planning rule and also could be of use to other natural resource agencies and planning efforts that are increasingly emphasizing and incorporating adaptive management (Schultz and Nie 2012).

Development of effective multiparty monitoring and adaptive management strategies has been a persistent challenge for the USFS and natural resource management in general. Understanding these efforts under the CFLRP provides a valuable opportunity to investigate the learning that is taking place as part of this innovative program and identify ways forward. Our research was designed to contribute to ongoing efforts to share best practices and explore options for addressing common challenges in conducting landscape-scale monitoring. We also endeavored to build a foundation for revisiting the CFLRP projects in the future to consider how their governance strategies developed over time, whether they were successful, whether monitoring objectives were met, and how groups approached the myriad challenges and opportunities encountered while developing and implementing monitoring and adaptive management strategies.

## Endnotes

1. For more information, see the USFS article, "A Retrospective Look," www.fs.fed.us/rmrs/about/history/.
2. For more information, see www.fs.fed.us/restoration/CFLRP.

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