

PRELIMINARY REPORT

The Design and Governance of Multi-Party Monitoring Under the Collaborative Forest Landscape Restoration Program



COLORADO FOREST
RESTORATION INSTITUTE

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Table of Contents

| | |
|---|----|
| INTRODUCTION | 3 |
| CONTEXT AND CRITIQUE | 6 |
| METHODS..... | 10 |
| INITIAL FINDINGS..... | 12 |
| Factors Driving the Design of Monitoring Strategies..... | 13 |
| Governance Frameworks | 16 |
| Challenges and Opportunities | 19 |
| CONCLUSION | 24 |
| LITERATURE CITED | 25 |
| APPENDIX A—CASE PROFILES OF CFLRP MONITORING STRATEGIES | 29 |
| The Southwest Jemez Mountains Project..... | 29 |
| The Four Forest Restoration Initiative..... | 31 |
| The Uncompahgre Plateau Project..... | 33 |
| The Colorado Front Range Project..... | 35 |

INTRODUCTION

Congress passed the Forest Landscape Restoration Act (FLRA) in 2009 to support implementation of collaboratively developed, landscape-scale restoration projects across priority forest landscapes on public lands.¹ The Act established the Collaborative Forest Landscape Restoration Program (CFLRP), administered by the U.S. Forest Service (USFS), which selects projects for funding based on submitted proposals with input from a federal advisory committee (for more details on the Act and its requirements, see Schultz et al. 2012). The purpose of the FLRA is to “encourage the collaborative, science-based ecosystem restoration of priority forest landscapes,”² and the Act outlines a number of primary goals: promoting ecological, economic, and social sustainability; leveraging local resources to accomplish these goals; reducing fire management costs through the reestablishment of natural fire regimes and reduction of the risk of uncharacteristically severe fires; demonstrating the degree to which restoration activities achieve ecological/watershed objectives and affect fire activity and its associated costs; and demonstrating how capturing the value of forest restoration byproducts can reduce treatment costs and support local economies.³ Each proposal for funding must outline how the proposed project will accomplish six specific objectives: 1) reduce the risk of uncharacteristic wildfire by mechanical thinning and the use of fire for restoration; 2) improve fish and wildlife habitat; 3) maintain or improve water quality and watershed function; 4) control or prevent invasions of exotic species; 5) conduct road maintenance, decommissioning or rehabilitation; and 6) use woody biomass and small-diameter trees produced by the projects.⁴

¹ P.L. 111-11, Title IV, 123 Stat. 991 (2009).

² Id. at §4001.

³ Id.

⁴ Id. at §4003(c)(3).

The FLRA is one of most significant pieces of forest policy legislation to pass in the last decade and is innovative in that it requires competitive allocation of funding to projects that are expected to clearly demonstrate achieved outcomes.



A Ponderosa Pine and Aspen stand in western Colorado after mechanical thinning

Another unique aspect of the legislation is that it requires all projects funded under CFLRP to utilize “a multi-party monitoring, evaluation, and accountability process to assess the positive or negative ecological, social, and economic effects of projects implementing a selected proposal for not less than 15 years after project implementation commences.”⁵ The USFS must submit to Congress an annual report detailing the accomplishments of each project, including the results of multi-party monitoring, and the Act also requires a five-year report to Congress detailing the extent to which the program is achieving its objectives. As noted above, one of the stated purposes of the Act 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.⁶ Thus, knowledge generation and learning are central components of the program.

It is rare that public land legislation requires funding and implementation of multi-party monitoring of the ecological, social, and economic outcomes of individual projects, although agencies have always had to report to Congress on their accomplishments, such as the amount of timber cut or acres burned. In a Senate hearing prior to the passage of FLRA,

⁵ Id. at §4003(g)(4).

⁶ Id. at §4001.

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 critical in the CFLRP context:

You know, the whole idea behind this landscape-scale restoration, it's somewhat experimental, and we have put in this proposed legislation significant requirements for monitoring in order to learn what's working and what isn't working. I mean that's the whole idea behind it. 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 (U.S. Senate 2008).

Given the unique legislative requirement to develop, fund, implement and report on multi-party monitoring, we investigated how CLFRP projects are developing their monitoring and adaptive management (AM) strategies. As this is a new program, there is a unique opportunity to get applied research started on the ground floor to understand the factors that drive the design and shape the governance of monitoring programs. Not only can we seek to understand what factors currently are shaping the design of monitoring programs, but we also will have an opportunity to look back in the future to see how and to what extent different monitoring programs were successful. There is also a role for researchers and other bridging organizations to support projects by sharing best practices, exploring options, and identifying solutions to common impediments.

This research project will investigate and report on the monitoring strategies of the first ten projects funded under the CFLRP (see Table 1). We chose to look at the first ten funded projects because they are likely to be further along in designing their monitoring strategies than are the projects funded in 2012 (no new projects were funded in 2011; see Schultz et al. 2012 for details). In this report, we discuss our initial findings based on our first four case studies: the Southwest Jemez Mountains, Four Forest Restoration Initiative, Uncompahgre Plateau, and Colorado Front Range (highlighted in Table 1).

Table 1. Size and Landownership Patterns for the First Ten CFLRP Projects⁷

| Project | Landscape Size | Ownership Patterns |
|---|--|---|
| R1: Selway-Middle Fork Clearwater (ID) | 1.4 million acres within the Selway and Middle Fork Clearwater River drainages | 94% Federal; 1% State; 4% Private; <1% Nez Perce |
| R1: SW Crown of the Continent (MT) | 1.45 million acres in the SW Crown, a sub-region of the Crown of the Continent landscape | 59% USFS lands; 11% Other public; 30% Private |
| R2: Colorado Front Range (CO) | 800,000-acre restoration zone along CO's Front Range (part of 1.5 million acre forest landscape) | 50% USFS 50% State and Private |
| R2: Uncompahgre Plateau (CO) | 1 million acres of various of cover types along the western slope of CO | 56% USFS; 1% State; 18% Private; 25% BLM |
| R3: Four Forest Restoration Initiative (AZ) | 2.4 million acres of contiguous Ponderosa pine across four National Forests in Northern AZ | 94% USFS lands 6% other (not specified) |
| R3: Southwest Jemez Mountains (NM) | 210,000 acres in the Upper and Middle Jemez River watersheds of central New Mexico | 93% USFS; 4% Private; 3% Pueblo of Jemez |
| R5: Dinkey Project (CA) | 154,000 acres of coniferous forest, foothill hardwood and chaparral, and mtn. meadows | 84% USFS 16% Private |
| R6: Deschutes Collaborative (OR) | 130,000 acres in headwaters of two Upper Deschutes Basin Creeks (municipal watersheds) | 75% USFS lands 25% private lands |
| R6: Tapash Forest Collaborative (WA) | 1,629,959 acres in central Washington's Kittitas and Yakima counties | 51% Federal; 15% State 10% Private; 24% Yakama |
| R8: Longleaf Pine Restoration (FL, GA) | 567,800 acres of largely longleaf and slash pine flatwoods in NE Florida and Southeast Georgia | 41% FS; 24% FWS; 15% Priv.; 13% Indus.; 7% State |

CONTEXT AND CRITIQUE

There have been numerous explorations and critiques of monitoring and AM in the natural resource management literature (Ringold et al. 1996; Stem et al. 2005; Nichols and Williams 2006; Nie and Schultz 2012). This section provides a brief summary of the key points from this literature in order to place the CFLRP in context and provide a foundation for exploring

⁷ Adapted from Schultz et al. 2012

creative solutions to some of the most pressing barriers to success that groups are now encountering.

The two most common types of monitoring are implementation and effectiveness monitoring. Implementation (or compliance) monitoring confirms that proposed actions were performed as described and is usually short-term, dealing with project outputs (e.g., acres thinned or burned, achieving target basal area, and preserving key ecological or archeological features). Effectiveness monitoring answers longer-term questions about how well a treatment worked in terms of achieving desired resource objectives (e.g., creating suitable wildlife habitat, changing fire behavior, improving water quality, and developing new markets). A third type, validation monitoring, could be considered a particularly rigorous form of effectiveness monitoring wherein researchers seek to better understand causal relationships between actions and outcomes (Morrison and Marcot 1995).

Both implementation and effectiveness monitoring can be pursued to quantify progress toward stated objectives as well as to promote trust, credibility, social learning, and increase accountability of resource managers to their peers, stakeholders, and the public (Doremus 2008; Fernandez-Gimenez et al. 2008). Further, effectiveness monitoring can be used to close gaps in our knowledge of fire-adapted ecosystems, specifically how to achieve restoration and how to manage for social and ecological resilience under a wide variety of current and projected future circumstances, including changes in climate, demographics, and local and global economic conditions.

Adaptive management is the systematic and iterative use of monitoring and evaluation to improve decision-making over time (Holling 1978; Moir and Block 2001; Folke 2005). It provides a framework to reduce scientific uncertainty, improve effectiveness and cost-efficiency, promote social learning, and increase confidence in management decisions (Schultz 2008; Biber 2011). Pre-defined triggers are important for

articulating future decision points in the AM cycle and ensuring that management changes occur based on monitoring information (Nie and Schultz 2012). Active AM involves the execution of management experiments that test specific hypotheses (Holling 1978). Passive AM is less rigorous and often



Stakeholders meet in the field to discuss a recent thinning treatment on the Colorado Front Range

includes the use of models (as opposed to field experiments) to facilitate learning about ecological process and systems through project planning and implementation (Walters and Hilborn 1978; Walters 1986; Williams 2011).

In the context of federal lands management, a standard definition, adapted from the National Research Council, is as follows:

Adaptive management [is a decision process that] promotes flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a ‘trial and error’ process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders (U.S. Department of the Interior 2009: v.)

Adaptive management “lite,” a phrase coined by Ruhl and Fischman (2010), is what is most commonly undertaken by natural resource management agencies when they claim to undertake AM. It involves no models or hypothesis testing but, rather, reflects on monitoring information in an ad hoc way to inform management. Adaptive mitigation, another approach taken by many federal agencies, introduces flexibility and discretion into

the implementation of management and mitigation measures used to achieve desired conditions and avoid negative consequences (Karkkainen 2003). The level of rigor or formality in an adaptive approach can be quite varied and depends to a large extent on the choices of parties involved based on their restoration goals, the level of uncertainty in the systems of concern, available funding, capacity, and level of commitment to monitoring and AM from both stakeholders and land management agencies. Because AM is a well-established decision-making paradigm in the natural resource and ecological literature, redefining the term in an ad hoc manner is problematic. People assign a specific understanding to the phrase, and therefore bring an attendant set of expectations. In order to avoid misunderstandings and reinventing the wheel, it can be useful for managers to be explicit about what type of adaptive decision-making process they are undertaking.

Monitoring has proven difficult for federal agencies, including the USFS, to commit to, fund, and implement (Ruhl 2008; Benson 2010; Ruhl and Fischman 2010; Doremus 2011). The same is true for AM; the formal elements of active application – controlled experiments and feedback loops – are rarely employed by federal agencies (Ruhl and Fischman 2010; Nie and Schultz 2012). There is concern with agencies adopting only some aspects of the paradigm, taking advantage of the flexibility afforded by AM, but either failing to include the scientific rigor that holds the most promise for reducing uncertainty or failing to establish pre-defined feedback loops that might require future management changes (Nie and Schultz 2012). Agencies face clear disincentives to monitor, especially when they have multiple-use mandates where resource extraction may compete with conservation goals, and some researchers have also found institutional barriers to AM, including prohibitions on experimentation or research, lack of training, and risk aversion in the face of litigation (Stankey et al. 2003; Doremus 2008). There are also considerable data collection, storage, interpretation, and synthesis demands that agencies frequently lack the capacity to manage;

in other words, data may be collected but then never translated into a useable form for managers (Doremus 2008).

Multi-party monitoring has been proposed by some as a partial solution to the problems of cost and accountability. It can be an effective way to engage stakeholders in the process of determining monitoring priorities, deciding where triggers points should be set and what management changes should occur when those points are reached, and ensuring a high-quality monitoring and AM process is put in place and implemented over time (Nie and Schultz 2012). By engaging stakeholders, citizens, and students in the collection, analysis, and interpretation of data, the burden of data collection and analysis is spread among capable partners (Deluca et al. 2010). CFLRP has the potential to play a significant role in demonstrating how landscape-scale multi-party monitoring can be effectively designed and implemented to improve natural resource management and decision-making.

Summary of Monitoring and Adaptive Management

Implementation and effectiveness monitoring are used to track progress toward stated objectives (e.g., desired conditions, outcomes). Multi-party monitoring (i.e., engaging stakeholders in the collection and use of information) can build trust and credibility, contribute to shared learning, and increase agency accountability.

Adaptive management creates the framework for collecting and using monitoring information to adapt management actions and decisions over time. Defined roles and responsibilities, decision-making triggers, and feedback loops are critical to effective and “active” adaptive management.

METHODS

This research utilizes a case study approach and qualitative methods, including document review and semi-structured interviews. Case study research is ideal for gaining insights into complex problems and is most robust when a systematic approach is applied to multiple cases, which can increase the generalizability of results to other settings (Schrader-

Frechette and McCoy 1994; Yin 2009). Our research approach is nested in a pragmatic worldview – one which focuses on application, action, and problem-solving – for which qualitative and mixed research methods are best suited (Creswell 2009).

The first ten funded projects under the CFLRP served as the primary case studies for this research. The primary research questions we asked were:

- 1) *What are the objectives of the projects' monitoring strategies and what factors drove the choice of those objectives?*
- 2) *What are the governance characteristics of each of the projects for their multi-party monitoring? In other words, how will they be funded and in what ways are they collaboratively designed and implemented?*
- 3) *What are some of the challenges that groups face in designing their monitoring programs and what strategies can we identify for overcoming these challenges?*

Cases were analyzed through a content review of documents, including the monitoring sections of the projects' CFLRP proposals, their written monitoring plans, which, for most cases, are still works-in-progress, and any other available documents relevant to monitoring, such as meeting notes. We also conducted semi-structured interviews with an average of six participants from each project. We targeted individuals directly involved in the design of the monitoring program, including both USFS personnel and outside stakeholders. Most projects have a monitoring working group of some kind, so we began by contacting the leads for that working group, along with the USFS lead for each CFLRP project, who was sometimes also a participant in the monitoring working group. From there, we utilized a snowball sampling approach to identify other key participants and interviewed at a minimum two agency personnel and two outside stakeholders. Although we could not interview everyone on each project who is involved with or interested in the monitoring, we sampled on each project until we had a comprehensive picture of the approaches and governance characteristics of the monitoring programs and were no longer hearing significantly new information. We recorded and transcribed all interviews and

utilized an open-coding methodology (Creswell 2009). We analyzed and categorized our findings based both on responses to specific questions in our interview schedule, such as how programs are funded, and on more general themes that emerged in response to questions around the overall purpose



Partners learn how to characterize an old stump during a multi-party monitoring trip on the Uncompahgre Plateau

of the monitoring strategies, quality of collaborative interaction between the agency and stakeholders, and key challenges associated with the design and implementation of the monitoring plans.

INITIAL FINDINGS

This section provides an overview of our initial findings regarding the monitoring objectives, governance strategies, and challenges faced by the CFLRP projects. The projects have a variety of monitoring objectives, but all of them share a focus on monitoring both implementation and effectiveness of treatments for ecological objectives. A number of individuals highlighted the importance of monitoring ecological responses, particularly in the CFLRP context, in order to maintain the social license to continue with restoration at large scales. All four projects discussed here are undertaking socioeconomic monitoring, although this is emphasized less than the ecological monitoring. While this relative focus is reasonable given the interests and expertise of USFS staff and stakeholders, socioeconomic monitoring remains a significant area for growth, since many of the challenges groups are facing (declining forest products industry, general public perceptions of restoration activities, effective facilitation, trust-building, etc.) are social and/or economic in nature.

We found a range of governance strategies in terms of the funding amounts dedicated to monitoring and the collaborative process for designing, implementing, and interpreting the monitoring frameworks and results. We also found that groups are facing a number of common challenges in designing their monitoring frameworks. Some are struggling with the distinction between monitoring and research. Others have yet to find a common definition for AM and a shared vision for how monitoring and AM are incorporated into planning documents. The design of CFLRP also has caused some groups to struggle with issues of timing, i.e. designing monitoring frameworks before desired conditions and predicted effects have been identified in NEPA documents. This section provides summary information on these findings; case profiles follow in an appendix with additional details on the four individual projects that informed this report.

Factors Driving the Design of Monitoring Strategies

Monitoring frameworks are being designed to ensure that treatments take place as planned, enhance understanding of the environmental effects of landscape-scale restoration, determine social and economic outcomes of projects, and build or maintain trust with stakeholders. Of concern, particularly to stakeholders, is that project implementation will take place as planned and effects will be within predicted ranges. This is especially an issue with the CFLRP because some projects are undertaking NEPA 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 thousand acres. The project will support the largest stewardship contract offered by the USFS to date: 30,000 acres per year for 10 years. Such an unusually large project-level NEPA document engenders nervousness on the part of stakeholders around several questions: What will be the landscape-level effects of such a project and will they be within predicted ranges? How

will desired conditions be translated into specific prescriptions on individual acres? And, where will there be checks and balances, once the decision is signed and the project underway? A USFS interdisciplinary team member explained:

[T]he sociopolitical ramifications are extremely important, and maybe even more important than the actual monitoring data that we get. Because to me, it'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 [to] the contract in the face of a signed NEPA.

NEPA analysis is also occurring at larger spatial scales on the Uncompahgre Plateau (UP), with projects related to the CFLRP increasing in size from a few thousand acres to more than 100,000 acres over the last few years. Regarding the purpose of monitoring for this new project, a USFS employee shared:

It's going to be a multi-year thing and a multi-contract 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.

Stakeholders and agency staff recognize and are working through the fundamental challenges and opportunities posed by large-scale, adaptive NEPA. Monitoring will play a critical role by documenting the landscape-scale and long-term effects of restoration, allowing for management adjustments in the face of monitoring information, and also ensuring that the agency continues to operate within the range of actions and predicted effects outlined in the NEPA document. Effective monitoring and a willingness to change management based on that information will help to build trust among stakeholders.

On the Southwest Jemez Mountains (Jemez) project the monitoring program was designed specifically to measure the ecological impacts of landscape-scale restoration and to show whether the project is meeting the requirements of the Act. There, one of the land

managers explained, “[W]e were very careful to go to the legislation and pick out all the things we’re supposed to be monitoring.” Monitoring objectives match the six objectives of the CFLRP legislation: restoring forest conditions, reducing fire risk and reestablishing natural fire regimes, improving fish and wildlife habitat, improving watershed function, controlling invasive species, and producing wood products for social/economic benefit.

The Colorado Front Range and UP projects also selected monitoring objectives that mirror the legislation and original CFLRP proposals. In addition, monitoring on the UP is driven largely by stakeholder interests and engagement. Their historical emphasis on citizen science and field-based learning is unique among the CFLRP projects nationwide and has contributed to high levels of trust and a shared understanding of desired conditions among stakeholders and the USFS. Ecological monitoring protocols have been developed by a local high school advanced placement biology class involved on the landscape for several years and revised through further stakeholder input and guidance from the Colorado Forest Restoration Institute (CFRI). Individual monitoring projects are also constructed to address important resource concerns like aspen decline (due to elk and/ or cattle grazing) and Canada Lynx, an endangered species found within the landscape.

Monitoring within the Colorado Front Range project is being designed, in part, to improve understanding of historic, current, and desired ecosystem conditions. For example, a subgroup of the project’s Science and Monitoring team developed a protocol for tracking the effects of restoration treatments on wildlife, within-stand structural heterogeneity, and understory vegetation. The concept of heterogeneity, both at the landscape scale and at the site scale, is based on studies of the historical structure of ponderosa pine ecosystems (Kaufmann et al. 2000, Larson and Churchill 2012). It is considered an important driver of restoration treatment designs and important for further study through monitoring. The size and complexity of the project landscape as well as participation from a wide range of

scientists and experts contribute to the complexity in defining desired conditions at the landscape scale.

Governance Frameworks

Groups have pursued a variety of governance frameworks, generally with some sort of oversight party or board,



The High Park Fire burning in the background reminds stakeholders of the need for restoration along the Colorado Front Range

either in place or envisioned, formal or informal. For instance, coordination of the Colorado Front Range and UP monitoring efforts is through a monitoring committee and issue-specific sub-committees, with much of the work being done by CFRI and group facilitation by another contractor. On the Jemez project, the Santa Fe National Forest and the Valles Caldera Preserve (the two USFS units involved), the Nature Conservancy (TNC), and the New Mexico Forest and Watershed Restoration Institute at Highlands University are the lead monitoring partners. The primary monitoring lead is the chief scientist at the Valles Caldera. S/he took lead responsibility for designing the monitoring plan, although the plan was vetted by a larger group of stakeholders (30-40 individuals) prior to submitting the plan with the CFLRP proposal. The lead partners work together to allocate funding and design sampling strategies; many partners also are contributing by designing, funding, and collecting data for individual monitoring projects. One USFS planner noted that monitoring is an area where stakeholders can be deeply involved in the project. Specific desired conditions and trigger points have not been identified at this time, although monitoring priorities have been arranged into tiers in order to select the highest priority projects in the face of limited budgets and capacity.

Stakeholders continue to be involved through an annual “all-hands” meeting, convened by

TNC, where results are reported and priorities for the next field season are discussed. However, there is no formal collaborative structure in place at this time for allocating funding, interpreting data, and feeding that data back into management decisions.

This lack of an established structure for the monitoring is a consistent feature across projects. On the 4FRI there was significant disagreement among interviewees, even within the USFS, as to whether there is a shared monitoring plan between the agency and stakeholders. One stakeholder explained that it was unclear to what extent the document exchange between the USFS and stakeholders, which began with a stakeholder-designed and approved monitoring plan, reflected a shared commitment to actually doing what is in that monitoring plan. The draft environmental impact statement (EIS) for 4FRI will be released soon, and there will be a monitoring plan included as an appendix. This should clarify the USFS' explicit commitments to implementation and effectiveness monitoring. However, the agency, or at least some agency staff, and stakeholders will likely intend to accomplish more than they are willing to commit to in the legally binding NEPA document. The governance of monitoring on the 4FRI is likely to become clearer in the near future. The 4FRI team indicated that they will be hiring at least two monitoring positions: one person to coordinate data and reporting across the four forests and one person, whose salary would be shared by stakeholders and the USFS, to work as a liaison with a stakeholder monitoring board. This monitoring board has yet to be designed, but the vision, according to stakeholder interviewees, is that they would operate as a board to set monitoring priorities, review data, and indicate when management changes would be appropriate.

Members of the Front Range Roundtable, the governing collaborative group for the Colorado Front Range CFLRP project, 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.

Funding for monitoring is running near 10 percent of CFLRP dollars for most projects. However, because funding from Congress is for implementation (not planning) and must be used in the same year it is allocated, it is not always clear to everyone on these projects how monitoring dollars have been spent thus far. On the 4FRI, some stakeholders believe the money has been held in an account for future monitoring, while others within the USFS indicated that it is “gone” and has been used for pre-project surveys. No one seemed entirely sure that there was a solid commitment to devote 10 percent of CFLRP dollars to monitoring on the 4FRI, despite intentions written into the CFLRP proposal, which itself is not binding. On the Jemez, all parties agreed there is a clear commitment to devote 8.9 percent of CFLRP dollars to monitoring, and the USFS is working to keep those dollars devoted entirely to effectiveness monitoring, viewing implementation monitoring as a required aspect of project implementation to be covered using other funding sources.

On the Colorado Front Range, the USFS has committed funds to monitoring through contracts to the CFRI and other entities for plan development, project implementation, and data analysis. The group has not identified a set percentage of CFLRP funds to go toward monitoring each year, but so far has invested both CFLRP and regular program dollars to the effort as well as solicited external funding from the National Forest Foundation (NFF) and the Department of the Interior through the Southern Rockies Landscape Conservation Cooperative (SRLCC). The UP project is taking a similar approach. Both groups are prioritizing monitoring projects in tiers to clearly move forward with the most pressing projects when funds are limited. The SRLCC funds have allowed the Colorado Front Range

project to pursue some “tier 2” monitoring projects related to wildlife populations, understory vegetation, and spatial heterogeneity. Funds from NFF are facilitating the UP’s look into desired future conditions and national indicators.

Challenges and Opportunities

There are a number of other challenges facing these projects. One issue that some groups are struggling with is the question of when monitoring becomes research. 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).”⁸

This distinction between what is monitoring and what is research is of concern and causing some confusion for CFLRP participants, particularly within the USFS. For instance, one USFS participant, when asked if their project was utilizing any controls in conjunction with their monitoring said, “No, because it’s not a research project.” Another USFS participant when asked about wildlife monitoring said, “That seems more research related, but it might be tied to adaptive management. I’m not sure.” This confusion is something we encountered in a number of projects. 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 questions. So that means you have controls, untreated areas.... So in that regard it’s very difficult to distinguish between research and monitoring.

⁸ <http://www.fs.fed.us/restoration/CFLRP/index.shtml/index.shtml>

Another stakeholder, who is both a scientist and manager working with one of the CFLRP groups, added that s/he has observed with other restoration efforts that “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.” Perhaps most importantly, s/he explained, “[If] it has value in answering what you see as monitoring questions, why would it matter whether you called it research or monitoring? ...If it is applied and I am going to be able to use it in the adaptive management process, then it’s all good to me.”

There are two important lessons here. One is that a monitoring program, if it is to be useful, must be scientifically valid; otherwise, the information will have limited utility to answer key questions, say anything about causality, and inform AM (see Nie and Schultz 2012, for a more in-depth explanation of these issues). Additionally, the important question with regard to CFLRP funding and distinguishing research from project monitoring is simply whether it informs the key monitoring questions and AM goals for that project and assesses the effects of that project’s restoration activities. If a monitoring activity is important for understanding the effects of a CFLRP project’s restoration treatments, then applying CFLRP dollars to answering that question, in a way that is scientifically sound (i.e., utilizing controls in order to have a point of comparison) is an appropriate use of that funding.

Timing is another challenge that these projects are facing and is an artifact of the nature of the CFLRP legislation and federal budget cycles. The Act requires that dollars be used to implement projects in the same year that the money is allocated. However, many of these projects, although they had a history of collaboration and a vision for landscape-scale restoration, had not completed a NEPA document (or documents) to meet those objectives or to specifically meet the goals of the CFLRP, often because funding had not yet been dedicated to these initiatives. Therefore, a number of projects have utilized CFLRP funding

to implement projects that generally meet their shared objectives but were through NEPA planning prior to the Act's passage. They also have used CFLRP dollars to do pre-project work such as biological and archaeological surveys to establish baseline conditions. All four projects are in the process of writing a new NEPA document (or multiple documents) for their CFLRP project. One stakeholder noted that it would be ideal to have a draft NEPA document done before developing a monitoring strategy, so that they would have a clear sense of the nature of treatments and predicted effects. These elements could then support the development of a monitoring plan that would be closely linked to the NEPA document, fully satisfy national program requirements, and more clearly facilitate learning and comparison across projects nationally. On the flip side, monitoring objectives now can be considered during the design of treatments, alternatives, and analysis of environmental effects. Another issue has been the timing of funding allocations. One USFS planner indicated that it was only in the third year of the CFLRP that they got their funding in enough advance to plan and collaborate on how to use it.

Another timing issue relevant to many projects and management of the program nationally is the development of national indicators that all CFLRP projects must report on annually (see Schultz et al. 2012).⁹ One USFS employee from the UP, when discussing the issue of having to adapt their 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.” In other words, opening up monitoring questions and protocols that have a great deal of stakeholder support and investment could be challenging. How this will affect future projects, monitoring, and stakeholder relationships remains to be seen. However, participants from each of the groups worked together to develop the framework for the national indicators that could be tailored to the individual goals of each project, so the space

⁹ See “Tracking and Reporting Ecological Outcomes of the Collaborative Forest Landscape Restoration Act” at <http://www.fs.fed.us/restoration/CFLRP/guidance.shtml>

exists to continue the conversation and push for monitoring that is relevant at multiple scales.

Adaptive management also figured into many conversations with CFLRP stakeholders and agency staff. Each group is developing a unique approach, but most have turned to more informal “learning-by-doing”. For example, the UP project is adapting stand-level prescriptions based on field tours with stakeholders and their perceptions of the effectiveness or suitability of treatments. Taking steps toward a more robust or “active” AM approach, 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. At the same time, a landscape-scale NEPA process is being undertaken for projects within the Upper Monument Creek watershed on the Pike National Forest. The goal is to construct an environmental assessment in a way that facilitates adaptation to new information and allows alternative management approaches within a single decision. As one stakeholder from the Front Range Roundtable 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?

To facilitate the development of this “adaptive NEPA,” the group is exploring use of Landscape Conservation Forecasting to model ecological systems and their departure from historic ranges of variability, model outcomes of various restoration strategies, and project return on investment for each strategy (Low et al. 2010). They are also discussing the use of

management experiments to test different ideas about how best to achieve restoration. This discussion is occurring within a collaborative space convened by TNC.

An important final question we put to CFLRP participants was whether the program is creating new incentives for monitoring. Universally, interviewees felt that CFLRP was elevating the importance of monitoring in project planning and implementation. Stakeholders often told us the provisions in the Act gave them the opening to engage the USFS in a discussion about monitoring. Individuals within the USFS stated that the Act creates the space and incentives internally to put increased emphasis on monitoring. One USFS interdisciplinary team leader noted that the high profile nature of the CFLRP project on their forest, the requirements of the Act, and active engagement from a stakeholder group all work together to increase attention on monitoring under CFLRP. Additionally, s/he noted that the renewed emphasis on monitoring in the new, 2012 USFS planning rule also compels them to think more about how to better accomplish monitoring.¹⁰ Designing the CFLRP monitoring effectively, noted several USFS planners on multiple CFLRP projects, is informing how forest plan monitoring will take place. In some cases, planners indicated that CFLRP monitoring data will support plan revision. In this way, CFLRP is part of larger shift within the agency toward improved attention and capacity devoted to landscape-scale, multi-party monitoring and may well be an incubator for developing and testing effective methods for implementing such monitoring.

¹⁰ 77 FR 21267

Summary of Initial Findings

Monitoring strategies are driven by a desire to measure the effectiveness of treatments at meeting ecological and socio-economic objectives, create and sustain social license to conduct restoration, and resolve key uncertainties (particularly at the landscape scale).

Governance frameworks are all based on collaboration but engage stakeholders in decision-making with the agency in different ways. Projects are devoting different amounts of resources toward monitoring and employing a variety of oversight structures for the collection and use of monitoring information.

Challenges and opportunities are many, and include striking an appropriate balance between scientifically valid monitoring and research, finding and sustaining consensus among stakeholders, defining and implementing adaptive management, and adapting to the timing of CFLRP funds and project activities.

CONCLUSION

Multi-party monitoring is a critical component of landscape-scale restoration and the CFLRP. It contributes to knowledge generation and learning, promotes accountability and trust among stakeholders, reduces uncertainty regarding landscape-scale and long-term effects of restoration, and supports AM frameworks that facilitate changes in project planning and implementation in response to monitoring information.

Initial findings from four of the first ten CFLRP projects included diverse and shared drivers of monitoring objectives: understanding landscape-scale effects, developing larger scale adaptive NEPA documents, meeting the intent of the CFLRP legislation, stakeholder participation and “citizen science,” and building trust and accountability. These objectives were crafted into monitoring programs using a number of collaborative processes and governance strategies. Similarities can be seen across projects in terms of funding amounts dedicated to monitoring and the collaborative process used for designing, implementing, and interpreting the monitoring frameworks and results. Common challenges and opportunities included distinguishing between monitoring and research, defining and pursuing AM, timing of project funds and activities (with respect to planning under NEPA and

federal budget cycles), and the incentives presented by CFLRP for improving USFS monitoring.

Our research contributes to and extends ongoing efforts to share best practices, explore options, and identify solutions to common challenges. It will provide a unique opportunity in the future to revisit the CFLRP projects and 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 their monitoring and AM strategies. Developing effective multi-party monitoring and AM strategies has been a persistent challenge for the USFS, and in natural resource management in general. This research and the CFLRP provide a key opportunity to investigate the learning that is taking place as part of this innovative program.

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APPENDIX A—CASE PROFILES OF CFLRP MONITORING STRATEGIES

The Southwest Jemez Mountains Project

Overview

The 210,000-acre Southwest Jemez Mountain project is located in central New Mexico and will take place primarily on the Valles Caldera Preserve (VCP) and the Santa Fe National Forest (SFNF). Restoration efforts will occur in ponderosa and mixed conifer stands in order to reduce the risk of catastrophic wildfire; 90 percent of these lands are within the WUI. Objectives will be met through treatments consistent with the collaboratively developed New Mexico Forest Restoration Principles, including combinations of thinning and prescribed fire (166,543 acres during the 10 years of FLRA funding), management of natural fires, road closures and rehabilitations, riparian zone restoration, and fisheries and wildlife habitat improvements. The SW Jemez project puts a strong emphasis on tracking the effects of these treatments through extensive scientific monitoring efforts.

Monitoring Approach

The project included a monitoring chapter with their CFLRP proposal that outlines monitoring goals in detail. It explains that the intent of the monitoring is to evaluate cumulative effects at the landscape scale and to evaluate treatment effectiveness for individual projects. Monitoring objectives match the six objectives of the CFLRP legislation: restoration of forest conditions, reducing fire risk and reestablishing natural fire regimes, improving fish and wildlife habitat, improving watershed function, controlling invasive species, and producing wood products for social/economic benefit.

The monitoring chapter places a clear emphasis on scientifically valid monitoring. It states, “The overall approach to the SWJM project’s monitoring program is to develop field monitoring activities in an “experimental” fashion, in which we establish statistically-replicated monitoring sites in both treated and untreated areas (equivalent to experimental “controls”), and measure the selected ecosystem variables prior to and after restoration treatments.” The project has common stand exam data for the entire project area, LIDAR data for measuring soil erosion, and GIS layers that will be consistently updated, to measure landscape-scale effects. They have put in new weather stations to track climactic conditions and a new flumes and gauges to measure hydrological effects; these are in addition to equipment that was already in place. Monitoring plots are being added to an already existing network of plots on the SFNF, Bandelier National Monument, and the VCP to measure understory response, vegetation conditions, prescribed fire effects, and biodiversity response; additional wildlife monitoring is also underway. The project also plans to measure economic activity, effects on hunting and grazing, and reductions in fire costs in response to the project. Depending on funding, the project has identified tiered monitoring variables based on their importance.

Governance

Monitoring and other aspects of the project will be collaboratively conducted by a large number of land managers and other participants. The lead partners for the project are the Valles Caldera Trust (a unique land management unit under the umbrella of the U.S. Forest Service but run independently by a board of directors), the SFNF, The Nature Conservancy (TNC), and the New Mexico Forest and Watershed Restoration Institute (NFWFRI).

The monitoring lead for the project is the chief scientist at the VCP, who wrote the original monitoring plan, based on collaborative discussions about monitoring priorities prior to submitting the proposal. The SFNF also has designated one of their staff as a

monitoring coordinator. The monitoring lead will coordinate data collection, management, and analysis, while TNC and NMFWRRI will work together to compile and house the data and conduct quality assurance and control. TNC plans to host an annual monitoring symposium where partners will discuss monitoring results and management implications. Partners feel that it is valuable to have a neutral third party oversee these discussion with partners and the public. Several small workshops have taken place where partners worked in small groups to decide upon monitoring details. A meeting also took place in 2012 to present the results of the monitoring data collected to date. The partners have yet to develop a more specific process for how monitoring information will be interpreted and fed back into future decision-making. Specific trigger points for management change have yet to be identified.

The USFS, after discussions among partners, decided to dedicate 8.9 percent of its CFLRP budget to monitoring, although some parties originally thought the number would be as high as 15 percent. All of this money is to be dedicated to effectiveness monitoring, as the USFS is considering implementation monitoring to be part of its general implementation budget. This money is being matched by the existing science program on the VCP and numerous other contributions from partners.

Challenges and Opportunities

One of the unique qualities of this CFLRP effort is the partnership between the SFNF and the VCP. The VCP has historically put 15 percent of its budget toward monitoring, Staff on the VCP indicate that this has given them expertise in monitoring, provided them with strong support for land management decisions, and has kept them out of court. All parties recognize that this expertise provides a valuable contribution to the effort, and some parties have more trust in the land management agencies, knowing that a scientist, with a track record of building a strong monitoring program, is overseeing the monitoring. Some note, however, that it also creates some tensions because of varying levels of commitment to and experience with monitoring between the various land managers. Additionally, the USFS ultimately may not commit enough money from CFLRP to accomplish everything laid out in the monitoring plan.

Land managers on this project note that the majority of outside partners are participating in this project through monitoring. Whereas partners often cannot conduct the restoration work, monitoring is an area where numerous partners can be involved and assess the outcomes of the project as a whole.

The Four Forest Restoration Initiative

Overview

The Four Forest Restoration Initiative (4FRI) is a project taking place across 2.4 million acres of ponderosa pine forest on four National Forests in northern Arizona. Its primary goals are to restore the ecosystem so that it is more resilient to fire and climate change over time, increase native biodiversity, reduce the risk to communities of wildfire, and to promote sustainable wood products industries that can support restoration efforts and strengthen local economies. The effort is the largest of the CFLRP projects and aims to undertake mechanical thinning on approximately 50,000 acres/year, with the goal of mechanically thinning approximately 1 million acres over the next 20 years. The 4FRI is currently conducting a project-level NEPA analysis across approximately 750,000 acres to identify treatment areas that will support a 10-year, 300,000-acre stewardship contract that was awarded in May 2012. The effort has a long history of collaboration (see Schultz et al. 2012 for details). The current stakeholder group has in place a charter that guides their activities, a memorandum of understanding (MOU) with the USFS, and a number of collaboratively written documents that capture their zone of agreement on restoration.

Monitoring Approach

The 4FRI stakeholders have developed biophysical, social, and economic monitoring plans that have gone through a series of revisions with input from the USFS. The biophysical monitoring plan is an effectiveness monitoring framework that specifies indicators based on 4FRI desired conditions, which come from the USFS' *Desired Conditions for Ponderosa Pine* and the *Landscape Strategy* developed by the stakeholders' Landscape Strategy Working Group.¹¹ More specific desired conditions may be identified in the forthcoming 4FRI draft EIS. Monitoring indicators are designed to be quantitative measures of the ecological effects of 4FRI project activities. The monitoring plan specifies the time interval for monitoring each indicator, the appropriate spatial scale for each indicator, and the range of detected values that would trigger an adaptive management response. Monitoring objectives are also organized into tiers, to indicate their priority. Indicators are identified for numerous aspects of ecosystem structure, composition, and process. The social monitoring framework identifies a number of survey questions that would assess community understanding and acceptance of 4FRI related activities and measures that would indicate the effectiveness of 4FRI activities on protecting values that are important to local communities. Likewise, the economic monitoring framework would assess the costs of restoration activities and the economic impacts on local communities. Both the social and economic monitoring frameworks include broad goals, specific objectives, targeted monitoring questions and metrics, and other specifics such as the frequency of assessments, data sources, and triggers that would indicate a need for management change.

Governance

The governance structure of the 4FRI monitoring effort has yet to be fully determined. At present, the above-mentioned monitoring plans have been approved by the entire 4FRI stakeholder group. The USFS provided input on these plans during their development. However, the USFS has made no clear commitment at this time to these plans. One interdisciplinary team member characterized these documents as a starting place for their

¹¹ The 4FRI *Landscape Strategy* is available at: http://www.fs.fed.us/restoration/documents/cflrp/2010Proposals/Region3/R3_4FRI/4FRI_Landscape_Strategy.pdf

work. The forthcoming draft EIS will include a monitoring plan as an appendix, at which time the USFS' explicit commitment to monitoring will be clearer.

The stakeholder group is in the process of developing a monitoring board, which might incorporate as an independent non-profit organization. The composition of this board has yet to be determined. It may be a subset of stakeholders who then consult with a group of scientists that are separate from the board, or the board may be composed primarily of scientists who are given a charge from the stakeholder group. The USFS has committed to hiring at least two positions: a monitoring coordinator who would work internally to coordinate monitoring efforts and manage data across the four National Forests and a second position, likely funded both by the USFS and stakeholders, who would serve as a liaison with the stakeholder monitoring board to collaborate on the governance aspects of setting monitoring priorities, allocating funding, interpreting data, and deciding how collected data should inform management decisions. At present, funding allocated to monitoring also has not been explicitly specified, although the CFLRP proposal indicates that 10 percent of CFLRP funds would go toward monitoring. The use of this funding to date is not something stakeholders are explicitly aware of at this time.

Challenges and Opportunities

The size of the 4FRI project and its EIS creates a situation where stakeholders are eager to monitor the landscape-scale effects of such a large effort and check whether treatments are taking place as envisioned with effects within predicted ranges. Monitoring is essential if there is to be broad support for such a large project and to ensure that the analysis for the ongoing decision remains valid. The envisioned multi-party monitoring board with a committed liaison from the USFS has the potential to be an effective governance structure to oversee the monitoring for this project in a way that is transparent and collaborative. Ideally this board would be set up soon so that decisions about monitoring priorities, dedicated funding, and trigger points for future adaptive changes can be tied to the final EIS, either through explicit commitments in that document or by linking monitoring decisions to the information in the environmental analysis. At present, stakeholders and the USFS are both unclear about the role of the stakeholder-designed monitoring plan, the amount of funding that is and has been dedicated to monitoring, and future roles, responsibilities, and commitments to monitoring. Clarifying these issues will be critical to an effective monitoring process moving forward.

Two other issues for the 4FRI project would benefit from additional clarification between the agency and stakeholders. There is confusion on this project as to what constitutes research versus monitoring. However, monitoring without controls will make it difficult to understand causality between restoration actions and outcomes. Scientifically sound monitoring that allows managers and stakeholders to understand the impacts of management actions is a valid use of CFLRP dollars. More general research projects could be funded through other means. There is also a variety of perceptions about what will constitute "adaptive management" for the 4FRI project. Some USFS staff indicated that simply having a variety of treatment options to utilize, depending on conditions found on the ground, is a kind of passive adaptive management. However, some stakeholders expect to see a more active approach that is based on robust monitoring, with controls and some replication, and changes in management based on the results of monitoring information. Additionally, they envision that pre-determined trigger points would be identified so that a feedback loop for adapting management based on monitoring information is explicit at the outset. Ensuring a common set of expectations for adaptive management would be useful to avoid miscommunication about expectations moving forward.

The Uncompahgre Plateau Project

Overview

The Uncompahgre Plateau (UP) landscape comprises approximately 1 million acres of federal, state, and privately-owned forest and rangeland ecosystems in western Colorado. Collaboration within this landscape began well before the Collaborative Forest Landscape Restoration Program (CLRP) and contributed to the identification of the project's goals. Broadly stated, these goals are resilience of native ecosystems and reintegration of wildfire into those systems. A variety of mechanical treatments and prescribed burns, weed treatments, and reseeded of native plants are being implemented across 160,000 acres and are tailored to the unique vegetation communities present (sagebrush, pinyon-juniper, mountain shrub, ponderosa pine, mixed conifer, aspen, and spruce-fir). At the same time, the project is targeting local job creation and the utilization of wood and woody biomass. Multi-party monitoring on the UP is based uniquely on citizen science and relies heavily on the active participation of local stakeholders and students.

Monitoring Approach

Monitoring efforts include pre-treatment and post-treatment measurement of overstory and understory vegetation with the goals of determining whether desired conditions have been met, informing adaptive management, and educating and engaging partners. The Colorado Forest Restoration Institute (CFRI) is on contract to coordinate monitoring efforts. A key component of each monitoring project, and the UP approach as a whole, is collaboration – collaborative development of goals and objectives, design of projects, collection and analysis of data, and interpretation for how to improve restoration work going forward.

Current monitoring projects include: studying the effects of cattle, elk, and deer browse on aspen; tracking ecological impacts of salvage logging in Burn Canyon; two biomass studies aimed at better understanding supply, feasibility, and public opinion; invasive species identification and control; tracking grazing and other management effects on riparian areas; and landscape-scale monitoring. The specific strategy for landscape-scale monitoring is still being developed. The group is also developing a website to facilitate entry, analysis, and visualization of multi-party monitoring data by multiple parties. Overall project success will be measured by meeting several key objectives, including: 1) moving toward desired vegetation and fuels conditions, including the reestablishment of native grasses and forbs; 2) sustaining timber mills and creating new biomass markets; 3) reducing long-term fire suppression costs; 4) decreasing catastrophic fire potential and utilizing wildfire for resource benefit; 5) improving wildlife habitat; and 6) adaptive management to adjust to climate change.

A concurrent project being used to establish baseline conditions and articulate more specific restoration goals is historic forest reconstruction or “forest forensics”. The methodology was used to produce a 2008 needs assessment and a 2011 current conditions report for the Uncompahgre Mesas project, a 17,200-acre restoration project that is part of the larger CFLRP landscape and has been informing the group's approach to restoration and multi-party monitoring.¹² Continued monitoring within the Uncompahgre Mesas project area is planned and funded, as is replication and adaptation of the methodology to other areas.

¹² The 2008 and 2011 reports are available at: http://coloradoforestrestoration.org/?page_id=491

Governance

Monitoring and other decisions are made collaboratively by the Uncompahgre Partnership, which has an Executive Committee, Monitoring Guidance Committee (MGC), and several monitoring project teams. Coordination and fundraising through external grant opportunities is handled by Uncompahgre Com, Inc. The Colorado Forest Restoration Institute (CFRI) continues to play a lead role in developing and implementing monitoring projects both as a contractor and stakeholder.

In FY 2012, \$138,500 was spent by the USFS and partners on monitoring, approximately 10 percent of total CFLRP project outlays. The same percentage was allocated to monitoring in 2011. Projects are prioritized annually based on funds available, previous investments, utility of information that will be provided, and the ability of projects to build new or strengthen existing relationships. A grant from the National Forest Foundation awarded in 2012 is being used to develop a clearer set of ecological desired conditions in line with national guidance and local needs, and a more robust approach to monitoring social and economic effects of restoration projects.

Challenges and Opportunities

The two biggest monitoring challenges facing the UP are the development of a strategy for landscape-scale monitoring and management of the wealth of data being produced by the various monitoring projects.

While landscape-scale objectives were developed for the smaller Unc Mesas Project and individual monitoring projects (like aspen browse) are being conducted plateau-wide, little has been done to define the monitoring questions, collect data, or conduct analysis across the entire landscape. This is increasingly important as more and larger projects come online like the approximately 100,000-acre Escalante project. Issues of both spatial and temporal scale are being considered, including how monitoring projects may nest within or relate to one another. For example, how does monitoring of a stand-level treatment relate to the Escalante or CFLRP project as a whole? How will CFLRP monitoring influence an update to the monitoring plan within the GMUG Forest Land Management Plan?

As more and larger projects are implemented and monitored by the host of stakeholders involved with the UP, data collection, storage, analysis, and management pose design, security, accessibility, consistency, quality and other challenges. Through a partnership with the Natural Resource Ecology Laboratory at Colorado State University, the group is exploring www.CitSci.org as an important collaborative data management tool. Their lessons learned and techniques developed may prove valuable to other landscapes.

The Colorado Front Range Project

Overview

The Colorado Front Range project is designed to treat approximately 34,000 acres of lower montane (primarily ponderosa pine) forest within a 1.5 million-acre landscape that stretches from Colorado Springs to Fort Collins and involves the Pike-San Isabel and Arapaho-Roosevelt National Forests, as well as state, county, and private landowners. These acres were prioritized on National Forest System lands because of their location within the wildland-urban interface (WUI) and departure from historical ranges of variability that characterize the forest ecosystems of this area. Treatments are being designed and strategically located to restore historic fire regimes (including frequent low-intensity wildfire) and reduce risks to ecosystems and communities. Reduced risk of severe wildfire means lower suppression costs to protect the region's valuable infrastructure (drinking water, homes, power and transportation corridors, etc.). The Front Range Roundtable is the collaborative group governing the project; its roots lie with the Front Range Fuels Treatment Partnership, which convened following the severe and costly Hayman Fire in the summer of 2002 and produced a document in 2006, *Living with Fire*, that outlined shared restoration goals as well as identified gaps in knowledge.¹³

Monitoring Approach

Monitoring of the Front Range restoration projects is guided by a monitoring plan; this document was finalized in June 2011 but is considered by the group to be a living document still undergoing revision and amendment. The approach is based on a shared commitment to collaborative learning and adaptive management, a concept that is also being fleshed out by the group. It includes both ecological and socio-economic monitoring projects.

Desired conditions were based off of the CFLRP proposal and include: 1) Establish a complex mosaic of forest density, size and age (at stand scales); 2) Establish a more favorable species composition favoring lower montane over other conifers; 3) Establish a more characteristic fire regime; 4) Increase coverage of native understory plant communities; 5) Increase the occurrence of wildlife species that would be expected in a restored lower montane forest; and 6) Establish a complex mosaic of forest density, size and age (at the landscape scale). Individual projects are designed to monitor progress toward these conditions and the monitoring plan includes detailed desired trends, variables to measure, methods and timing of measurements, and scale of analysis. Most trends are measured at the stand scale; landscape-scale indicators include fire behavior (modeled) and habitat structure. Remote sensing and LiDAR are being explored as means to address large-scale issues like landscape mosaics and variations in stand structure.

Social and economic monitoring is being conducted through document review, surveys, interviews, and focus groups. Questions revolve around the ability of restoration to enhance community sustainability, improve local restoration business and workforce skills, improve or maintain local quality of life, improve capacity for collaboration, and build support for forest restoration. Monitoring projects were organized in tiers so that decisions about what to prioritize with available funding could be made.

Governance

The monitoring plan was developed by the Science and Monitoring Team with input from members of the Roundtable during a series of meetings in 2010-11. The Colorado Forest Restoration Institute (CFRI) was and is the lead contractor, facilitator, and responsible party

¹³ The full report is available at http://frontrangeroundtable.org/Mission_and_Background.html

for designing and implementing the monitoring plan. Beh Management Consulting handles overall facilitation and coordination for the Roundtable and committees as needed. CFRI and other teams of researchers and USFS staff on the participating forests are conducting individual projects. Funding for monitoring is coming from the CFLRP as well as regular program budgets on the forests, which have been supporting some of the pre-treatment monitoring, relevant inventory work, and implementation monitoring on the “NEPA-ready” restoration projects that have begun to move forward. Approximately \$400,000 is expected to be invested over the 15-year life span of the monitoring plan, including a grant from the Southern Rockies Landscape Conservation Cooperative (SRLCC) obtained by members of the Science and Monitoring Team to pursue some of the Tier 2 variables pertaining to wildlife populations, spatial heterogeneity, and understory vegetation.

Challenges and Opportunities

A naturally complex and extensive ecosystem, the Colorado Front Range is in the middle of what by many accounts is an unprecedented bark beetle epidemic that is being exacerbated by climate change. This interaction raises questions about where the lower montane ecosystem is headed and how best to set it on a path to resilience through mechanical treatment and prescribed burning. At the same time, the Front Range is home to millions of people and visitors, creating complex patterns of recreation, development, and social values related to forest management and the forest products industry that increasingly is seen as an essential component of any successful landscape-scale restoration strategy. The region is also host to numerous research institutions (USFS Rocky Mountain Research Station, U.S. Geological Survey, Colorado State University, University of Colorado, Rocky Mountain Tree Ring Research, etc.) and a healthy diversity of expert opinions. This complexity and diversity makes the Front Range an interesting and necessary place to work, but poses significant challenges to building and sustaining consensus.

One response to this complexity is the collaborative group’s pursuit of adaptive management and “adaptive NEPA” in order to create a framework for project planning, implementation, and monitoring that is responsive to change and new information. A program-wide adaptive management strategy is currently under development and a planning experiment is just beginning on the Pike-San Isabel National Forest to collaboratively develop an adaptive NEPA document for a project in the Upper Monument Creek watershed.