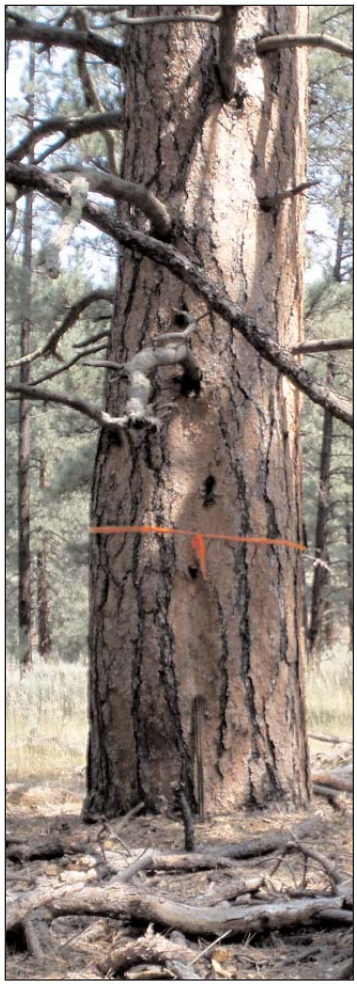
MONITORING THE LONG TERM ECOLOGICAL IMPACTS OF NEW MEXICO'S COLLABORATIVE FOREST RESTORATION PROGRAM



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New Mexico Forest Restoration Series
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5

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Executive Summary

In January 2008, the Collaborative Forest Restoration Program (CFRP) Monitoring Assistance Team was tasked with developing recommendations for the 15-year ecological monitoring requirement, as set forth in founding legislation of the program. We reviewed monitoring plans and protocols for all 102 projects funded through 2007. This paper outlines the methods employed in our analysis, criteria for recommending a subset of 20 projects, and recommended indicators and protocols for long term monitoring. Overall, we found that more than forty percent of CFRP projects with site treatments had planned or implemented reliable ecological monitoring methods. Of these projects, we recommended 20 for long term monitoring based on a suite of criteria, including the number of indicators, forest type, land tenure, and geographic distribution. We developed a long term monitoring timeline for the 20 recommended projects, following 5, 10, and 15 year intervals after project treatment. We recommend leaving the responsibility for determining monitoring indicators and protocols in the hands of the project's multiparty monitoring team to best address specific project goals. However, to insure that reasonably consistent and comparable ecological data is collected, we recommend that all grantees monitor the following five indicators, using standard agency, tribal or CFRP protocols:

- Canopy cover (%)
- Understory cover (% ground and/or shrub)
- Surface fuels (tons/acre)
- Crown base height (ft)
- Stand structure
  - Tree species
  - Size (DBH, DRC inches)
  - Density (stems/acre live and dead, basal area).

We presented these recommendations to a subcommittee of the Technical Advisory Panel of the CFRP in August 2008. The Panel reviewed and revised these recommendations for the 2009 Request for Proposals for the CFRP.

Finally, to address a concern expressed by community members, agency personnel, and consultants alike about the need for improved data sharing and interpretation, we recommend that all CFRP projects follow the multiparty monitoring process described herein, and in all monitoring assistance guides, so that shared learning is encouraged among all stakeholders.

Introduction

The Collaborative Forest Restoration Program (CFRP) was created in 2000 through the Community Forest Restoration Act (Title VI, Public Law 106-393) to (i) address conflicts over forest management in New Mexico, (ii) promote forest ecosystem health and sustainable communities, and (iii) develop innovative uses and capacity for small diameter wood utilization. Since its inception, CFRP has funded 116 projects throughout the state, and has served as a model for other programs. CFRP provides cost-share grants to collaborative groups for forest restoration. To date, the program has funded the restoration of ponderosa pine, piñon pine-juniper, mixed conifer, and bosque forest types, as well as riparian areas of conifer forests.

All CFRP grantees are required to use a multiparty team to identify the existing and desired future ecological conditions of the project area and report on the impacts and effectiveness of their project (Public Law 106-393, Section 605). In addition, the Act requires that the program create a multiparty monitoring process to assess program accomplishments and/or adverse impacts. The Act specifically calls for monitoring of "the short- and long term ecological effects of the restoration treatments" for at least 15 years (Public Law 106-393, Section 607). The CFRP requires individual grantees to monitor the effects of their work during and after project implementation. However, following project completion, the New Mexico Forest and Watershed Restoration Institute is ideally positioned for monitoring all long term project impacts.

In Section 1, we review the multiparty monitoring process employed for ecological monitoring of CFRP projects. In Section 2, we describe the methods used to conduct a meta-analysis of the 102 projects that were funded at the time of analysis and recommend 20 projects for long term monitoring. In Section 3, we present our final list of 20 recommended projects in the context of all 102 CFRP projects. We discuss recommended indicators and protocols for long term monitoring in Section 4, and present a timeline for long term monitoring of the 20 recommended projects.

Section 1. Multiparty Monitoring Process

What is Multiparty Monitoring?

Monitoring is the process of collecting and analyzing data periodically to determine whether a project or program is meeting its goals and target conditions. It is frequently used for adaptive management, so that land managers and others engaged in restoration can adjust their management to achieve desired results as new information becomes available.

Multiparty monitoring brings together a diverse group of people, including land managers, environmental groups, community organizations, and forest practitioners to participate in the monitoring process. Multiparty monitoring can increase public participation in public land management. For community forestry advocates, multiparty monitoring is an important process in conflict management and shared learning. For scientists and land managers, it may be a method of achieving greater data reliability. And for funding entities, multiparty monitoring is a tool for project evaluation and accountability (Moote et al. 2007). Because multiparty monitoring is mandated for CFRP, we provide a detailed discussion of it here, as it relates to our analysis of CFRP projects and recommendations for long term ecological monitoring.

Development of Multiparty Monitoring within CFRP

In 2001, when the first projects were funded, there was little shared understanding among grantees about the multiparty process, what should be monitored, and how much to budget for monitoring activities. In 2002, a group of more than 40 land managers, academic and agency researchers, community forestry organizations, and forestry practitioners were brought together to discuss multiparty monitoring for CFRP and to generate guidelines for multiparty, ecological, and socioeconomic monitoring (USDA Forest Service 2003). The following year, a CFRP grant was awarded to the Ecological Restoration Institute to provide technical assistance to CFRP grantees in all aspects of monitoring (CFRP grant #28-03). With this funding, the technical assistance team created a series of handbooks that simplified the 2003 guidelines (http://www.fs.fed.us/r3/spf/cfrp/monitoring) and provided a series of workshops and on-site monitoring assistance to any grantee who requested it. After the grant completion in 2007, CFRP contracted the New Mexico Forest and Watershed Restoration Institute at New Mexico Highlands University to continue providing

this assistance. Our experience from 2001 to the present shows that CFRP projects have used a diversity of approaches in fulfilling the multiparty monitoring requirements of the Act.

The CFRP monitoring guidelines provide a five step multiparty monitoring process as follows:

> **"The multiparty process remains critical to achieving forest restoration goals."**

- Convene a multiparty meeting
- Write a monitoring plan
- Gather data
- Analyze data and adapt project as needed
- Share results (and repeat as needed)

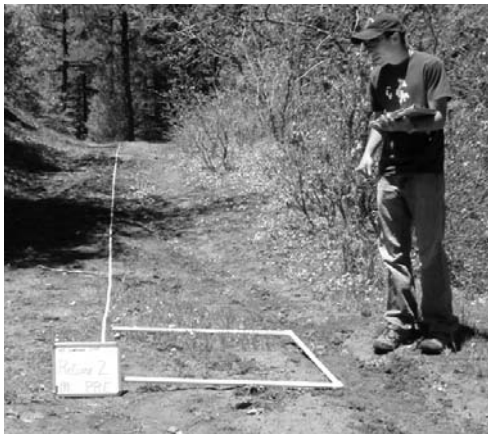
(CFRP 2005, Moote 2008).

Despite the fact that participation in the multiparty process has varied considerably among CFRP projects, our experience clearly demonstrates that the process remains critical to achieving forest restoration goals. The following cases illustrate ways the multiparty process can strengthen restoration and reduce conflict.

Ensenada Forest Health and Restoration Project (Grant #25-05)

The objectives of this project were to restore forest structure and function, re-establish meadows and aspen, and re-introduce fire. The project engaged a multiparty team with more than 20 participants in an intensive monitoring process. The project began with collaborative meetings to establish the grant proposal and continued after the grant was awarded. The multiparty team guided the grant in many stages including:

- developing the CFRP grant proposal
- developing a multiparty monitoring plan
- collecting and interpreting monitoring data
- developing restoration targets based on monitoring indicators
- developing collaborative prescriptions, and
- improving restoration prescriptions from one stand to the next.



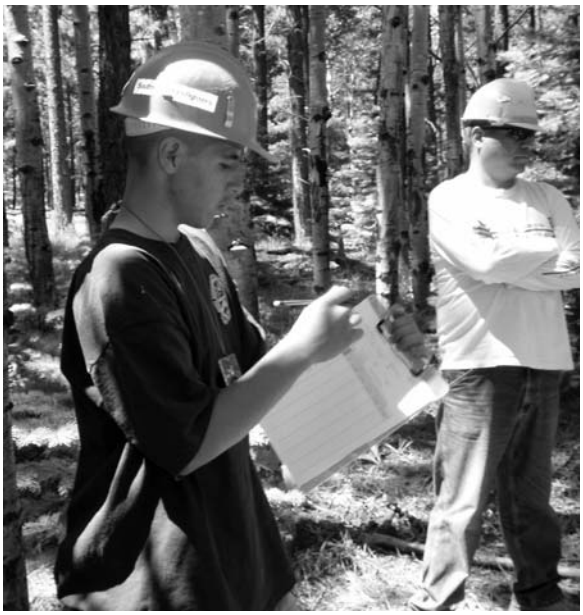
The multiparty process was important in aiding the resolution of a disagreement between the Forest Service and the grantee (Alfonso Chacon & Sons, "Chacon"). In late 2006, the El Rito Ranger District and the Carson National Forest prescribed burn crew determined the CFRP site unsuitable for burning due to heavy surface-fuel loading. Chacon argued that the site had similar fuel loads to other projects that had been burned with prescribed fire and that full surface fuel removal was not part of his responsibilities outlined in the approved grant agreement.

This disagreement stemmed from alternative interpretations of the language in the approved grant document. At that time, the monitoring team had gathered both baseline and post-treatment surface fuel data. These data were used to inform the multiparty team about the extent of surface fuel generated, which was beyond the amount of surface-fuel loading the local Forest Service prescribed fire team was comfortable burning. The multiparty team and Chacon acknowledged that the return of surface fire to the stand was a high priority, and Chacon agreed to remove additional surface fuel to create site conditions conducive to the return of prescribed surface fire. After surface fuels were removed by Chacon, the monitoring team re-collected the surface fuel data and found that surface fuel loading was reduced to an appropriate level for broadcast burning.

This concession significantly changed the course of the grant due to the high cost of fuel removal from this remote site, and as a result, some restoration treatments were eliminated. Nevertheless, sharing the available surface fuel data collected by the multiparty monitoring team provided common ground that contributed significantly to resolving the conflict.

Zuni Healthy Forest & Watershed Initiative (Grant #11-04)

The objectives of this project were to provide saw timber logs to support Zuni's traditional wood product business and to reduce hazardous fuels and restore ponderosa pine forest structure in several high priority wildland-urban interface (WUI) and non-WUI areas in the Zuni Mountains. After baseline data had been collected, the multiparty team met at one of the project areas south of El Malpais National Monument to collaboratively develop a restoration prescription that would meet objectives of both the grantee (Zuni Forest Products, "Zuni") and the land management agency (Bureau of Land Management, "BLM").



The group walked the site with baseline monitoring data in hand and discussed the strengths and weaknesses of the existing forest condition. Strengths included existence of old and large trees of multiple species, clumpy arrangement of older trees, no apparent non-native invasive species, a healthy oak community for wildlife habitat, and a low basal area (64 square feet per acre). The group also identified undesirable ecological conditions, including a preponderance of oak seedlings, a lack of ponderosa pine seedlings, and a large number of saplings that would serve as ladder fuels in a fire. The group discussed the presence of two distinct vegetative communities on the north and south slopes of the project area that would need

separate restoration prescriptions. The group also found that only a few areas had both larger diameter trees (14-18" at breast height) and gentle enough terrain for log removal.

Following the site survey, the group developed prescription recommendations related to invasive species, stem cutting, slash management, dead standing trees, ponderosa pine dominant areas, and mixed species woodland areas. The BLM was initially hesitant to allow larger tree removal and to follow a lop and scatter slash treatment. They also wanted Zuni to cut abundant oak seedlings in order to reduce fuels quickly and allow a one-time fire entry. Zuni was concerned about treating all the oak, as it would significantly raise the cost per acre of the treatment. They also were concerned about obtaining enough larger diameter trees, given the low basal area on the site.

The group agreed that a broadcast burn would be written into the NEPA plan and identified larger trees of multiple species that could be cut for wood utilization. Thus Zuni would be able to remove some logs for their business needs while the site retained its large tree component. With the anticipated broadcast burn, the agency agreed to let the fire suppress abundant oak rather than require the crew to manually cut the shrubs. The group also agreed on a lop and scatter slash treatment, which would expedite understory recovery and facilitate the burn. The group all agreed that this prescription would help achieve desired future conditions while helping keep the cost per acre as low as possible for Zuni.

Section 2. Meta Analysis and Project Selection

We conducted a meta-analysis of all 102 CFRP projects funded through 2007 by reviewing CFRP proposals, monitoring plans, mid-project updates, and final reports. We were unable to access complete documentation of some projects, resulting in gaps in information. Where possible, we gathered information to complete these gaps through phone calls, personal meetings, and on-the-ground experience. In general, we found that variability in data reporting is a weakness in CFRP monitoring.

Our meta-analysis of the final data set assessed trends throughout the CFRP program by examining the distribution of all 102 projects in the following categories:

- Forest type
- Forest Service management unit (as a proxy for geographic location)
- Project actions (e.g., thinning, planning, burning, etc.)

- Land tenure for treatment areas
- Treatment type
- Ecological indicators monitored, and
- Reliability of ecological monitoring.

This meta-analysis also served as the basis for selecting 20 projects for long term ecological monitoring. First we evaluated all 102 CFRP projects to determine which projects had the greatest potential for long term ecological monitoring. To establish which projects were suitable for monitoring, we focused on projects with restoration treatments, and whether or not monitoring data had been collected prior to and after the treatment. We eliminated 18 business and planning projects because they did not apply restoration treatments. We then examined the reliability of ecological monitoring on the remaining 84 projects.

Critical to our analysis was the existence of pre-treatment baseline data, which is essential for determining the ecological impact of restoration treatments. We also chose projects based on the number and types of indicators monitored to increase the likelihood that projects selected for long term monitoring shared indicators in common. While these selection criteria bias our sample toward projects with reliable monitoring, we felt these criteria were essential in that it would not be possible to provide information about long term program effects without baseline data and shared indicators. Thus, we examined each project to determine how many of the following ecological indicators were monitored:

- Tree species, size, and density
- Canopy cover
- Understory cover
- Surface fuels
- Photo points
- Basal area
- Understory composition
- Crown base height
- Water (any water quality or quantity parameters) and
- Wildlife (any wildlife monitoring).

We focused on projects that had the highest number of these indicators, eliminating those that had monitored less than three indicators. We also examined the sample size, use of standardized protocols and first-hand knowledge of the monitoring data to assess the reliability of ecological monitoring.

Based upon this initial analysis, we concluded that 45 out of the 84 restoration projects had reliable ecological monitoring data. We generated a list of 30 projects with the highest potential for long-term monitoring (Appendix 1). Our final target was 20 projects, a number that realistically permits a broad selection of projects for monitoring in each National Forest management unit[1] and forest type over the 15-year period. To do this, we evaluated projects in each National Forest management unit based upon the following five criteria:

- Forest type (e.g., ponderosa pine, piñon-juniper, mixed conifer, bosque)
- Treatment type (e.g., hand or mechanical thinning, burning)
- Land tenure (e.g., Forest Service, Bureau of Land Management, tribal, land grant)
- Unique project features (e.g., beaver restoration, mulch treatments, road closure)
- Coordinator priorities.

We attempted to select a number of projects in each management unit that reflected the total proportion of CFRP projects in that region. We also selected projects that offered a balance of different forest types, restoration treatments, and land tenures. We tried to select projects that were geographically distributed throughout each management unit.

Prior to narrowing these projects down to our final target of 20, we presented our list of 30 recommended projects to the CFRP Technical Advisory Panel (TAP)[2] in April 2008. In particular, the TAP cautioned against selecting only the "strongest" projects that demonstrated the greatest success in project implementation and treatment impacts. The concern was that such a selection would fail to capture the diversity of project impacts across the CFRP program. The TAP recommended including projects that demonstrated both strengths and weaknesses in project implementation and impact. To address these concerns, we analyzed each recommended project to outline strengths and weaknesses in project implementation and potential ecological impact. For example, while some projects used sound science, restored important watersheds or produced innovative products with small diameter wood, they may have lacked long term planning for fire reintroduction or other means of ecosystem maintenance.

An emphasis was placed on balancing forest type so that long term monitoring results would be relevant to a variety of forest ecosystems. Land tenure and unique project features also influenced our selection of projects within each forest type. Our final list of 20 projects was recommended for 15-year ecological monitoring by a TAP subcommittee in August 2008.

[1] Each CFRP grant is assigned to one of New Mexico's five national forests and associated program coordinator for grant management.

[2] According to CFRP Technical Advisory Panel Bylaws, the Panel is responsible for evaluating proposals for forest restoration grants and providing recommendations on funding. A subcommittee of the Panel also met to provide guidance and recommendations for long term monitoring of CFRP.

Section 3. CFRP Program Trends and Projects Recommended for Long Term Monitoring

Meta-Analysis Results

Among the 102 CFRP projects funded from 2001 to 2007, over three quarters (76%) included an on-the-ground treatment. The other CFRP projects involved solely planning or business development. Nearly half (44%) of CFRP projects that involved on the ground treatments had reliable ecological monitoring methods planned or implemented. One quarter of the projects had ecological monitoring methods that were assessed as having low reliability. Of the 20 projects recommended for long term monitoring, most monitored at least five indicators, with some monitoring as many as eight. All projects identified for long term monitoring measured tree size, species, and density. More than 80% also measured canopy cover, understory cover, and surface fuels. Fewer monitored water (25%) or wildlife (30%).

The majority of projects with treatments were undertaken in ponderosa pine and a large percentage of projects treated more than one forest type (Figure 1).

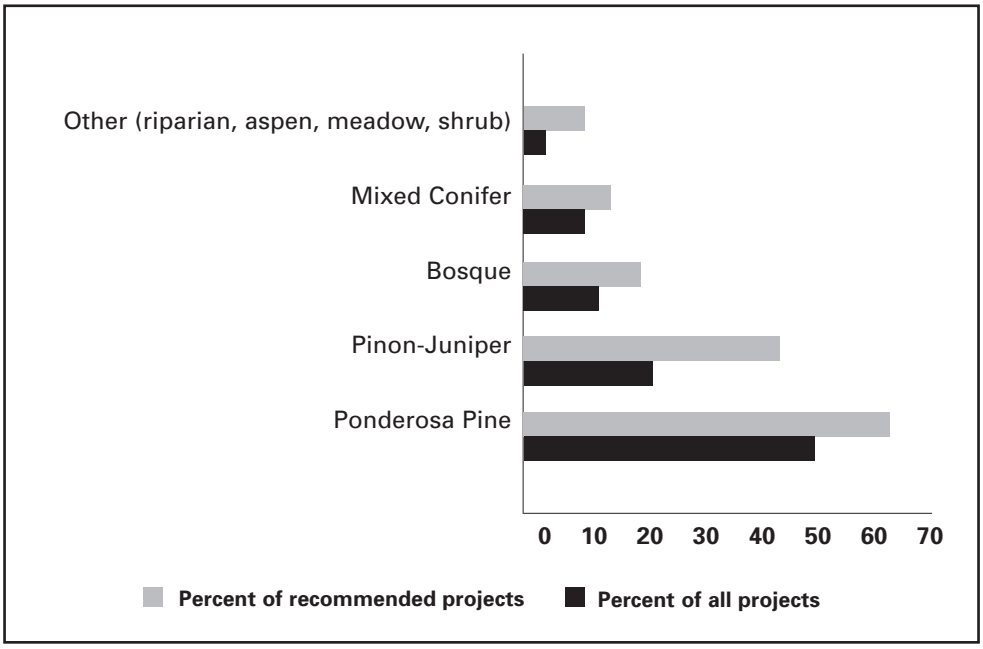


Figure 1. Proportion of forest types in all CFRP restoration projects and those recommended for long term monitoring. Some projects treat multiple forest types.

Treatments were most commonly implemented on U.S. Forest Service land (44%), followed by tribal land (21%). Eleven projects were multi-jurisdictional. The not-applicable category refers to projects that did not include treatment either because they were for planning, acquisition of equipment, or some other action that did not involve on-the-ground treatment (Figure 2).

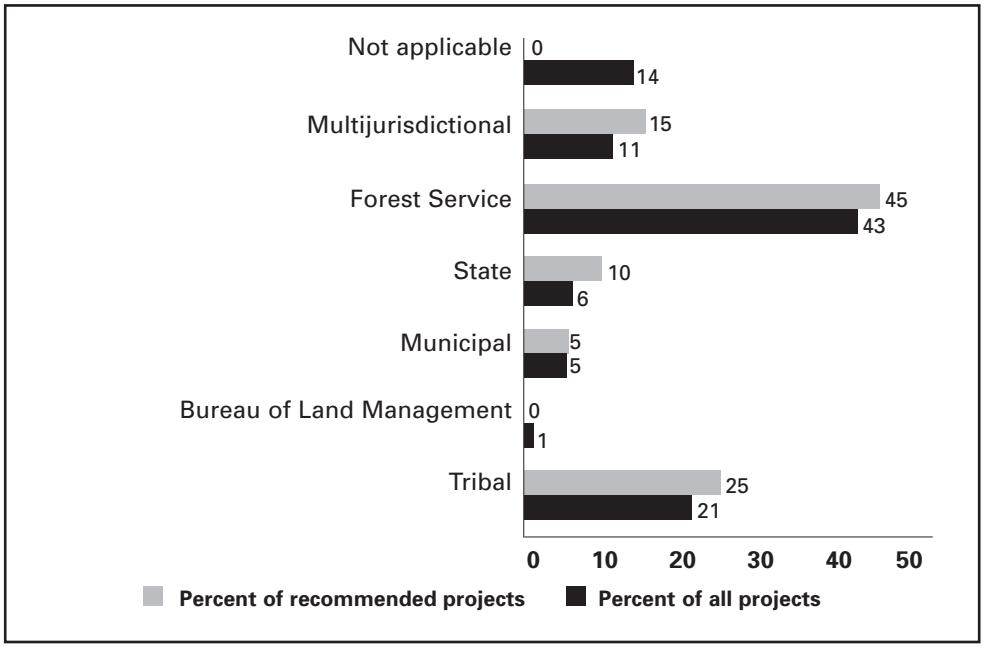


Figure 2. Land jurisdiction for treatments of CFRP projects. Some projects take place on multiple land jurisdictions.

The Santa Fe National Forest (NF) has served as the administrative unit for 38% of CFRP projects, while the Cibola, Carson, and Gila NF each account for a little less than 20% of the projects. The Lincoln NF administered only 8% of CFRP projects (Figure 3).

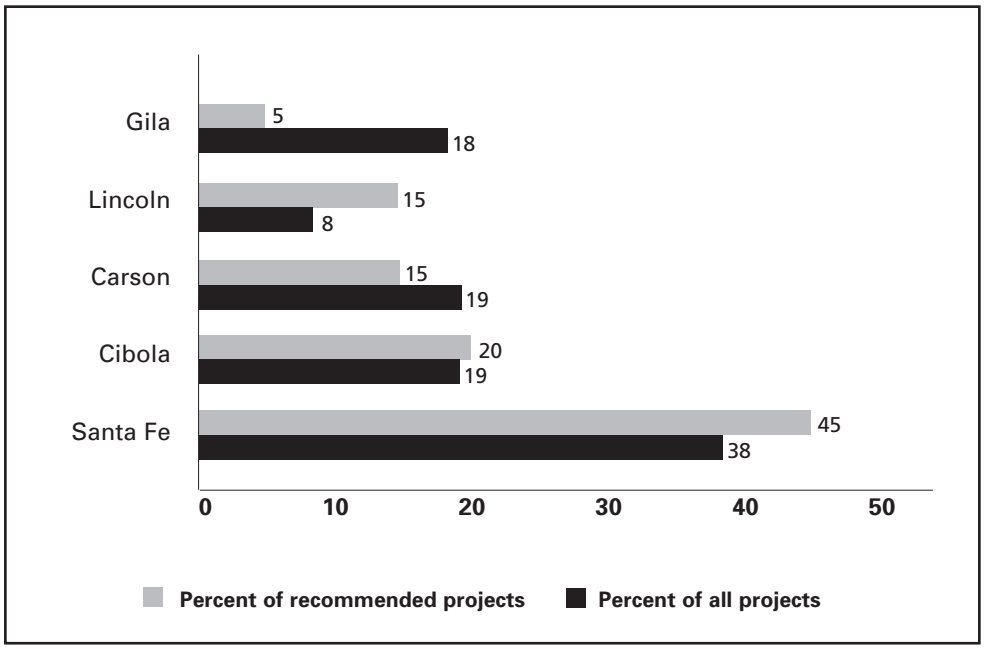


Figure 3. Distribution of CFRP projects among national forest management units

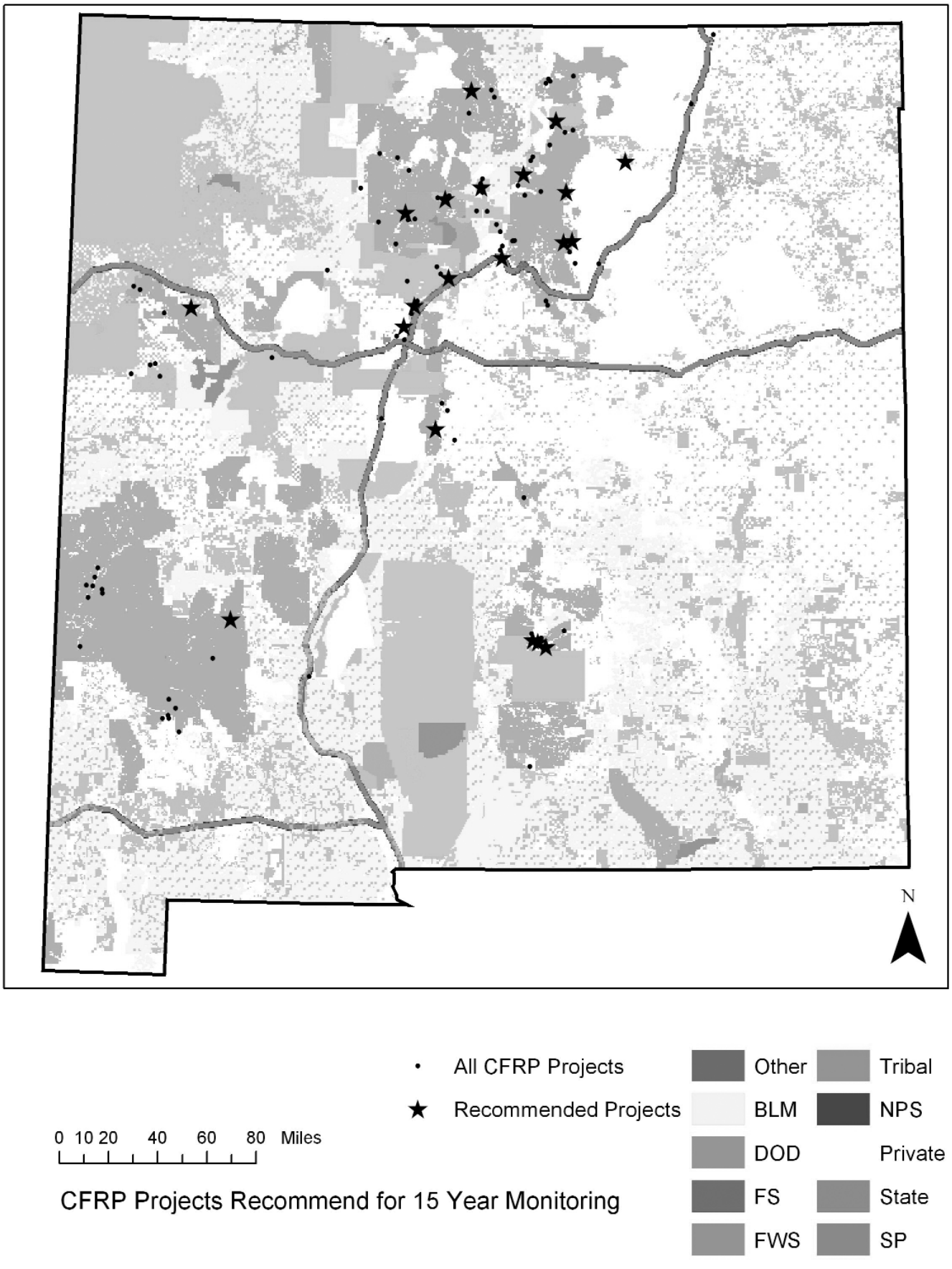
Recommended Projects for 15-Year Monitoring

For the most part, the 20 selected projects (Table 1) were reflective of CFRP projects as a whole. For example, projects that treated ponderosa pine comprised a majority of those recommended for long term monitoring, although a large percentage of projects treated multiple forest types (Figure 1). Over two thirds of the projects recommended for monitoring were located on Forest Service or tribal lands, which reflects CFRP project allocations in general (Figure 2). Nearly half the recommended projects were in the Santa Fe National Forest, also reflecting overall CFRP trends. Recommended projects in the Lincoln were slightly over represented, compared to their total number in the CFRP program, while projects in the Gila were slightly under represented (Figures 3 and 4).

Table 1. Final 20 projects recommended for 15-year monitoring by forest type. Numbers in parentheses indicate the niumber of ecological indicators monitored.

Ponderosa Pine	Pinon-Juniper	Mixed Conifer	Bosque/Riparian
28-05 Ensenada (7) Carson NF	16-07 FG III Santa Cruz/Embudo (7) Carson NF	33-05 Taos Pueblo (6) Carson NF	16-01 MRGCD Bosque (8) Cibola NF
02-05 P&M Thunderbird (5) Cibola NF	01-05 Bluewater (8) Cibola NF	03-01 La Jicarita (8) Santa Fe NF	06-02 San Juan Bosque (5) Santa Fe NF
39-05 SBS II - Cedar Creek (4) Lincoln NF	05-07 Santa Ana Juniper II (7) Cibola NF	22-04 Gallinas - Tierra y Montes (8) Santa Fe NF	25-07 Santa Clara Pueblo Beaver (4) Santa Fe NF
21-04 Sierra SWCD Black Range (5) Gila NF	36-04 Turkey Springs Ruidoso (5) Lincoln NF	13-07 Ruidoso Schools (5) Lincoln NF	28-07 Santo Domingo Forest to Farm (6) Santa Fe NF
11-01 LTRR Monument Canyon (6) Santa Fe NF	27-04 Santa Fe FD WUI (7) Santa Fe NF	22-07 Barela Timber (6) Santa Fe NF	
29-07 SWPT - Ocate State Lands (5) Santa Fe NF			

Figure 4. Map of CFRP projects recommended for 15 year monitoring



All projects selected for long term monitoring had been or will be thinned, with only a few having also been burned (Figure 5). Because all restoration projects require maintenance beyond the time-frame of project implementation, this finding highlights the need for follow-up controlled burns, which would restore process, as well as structure, to a site. Half of the recommended projects applied thinning treatments by hand, while only three out of 20 were treated solely mechanically (Figure 6). For many of the 102 projects, we were unable to determine the type of treatment applied.

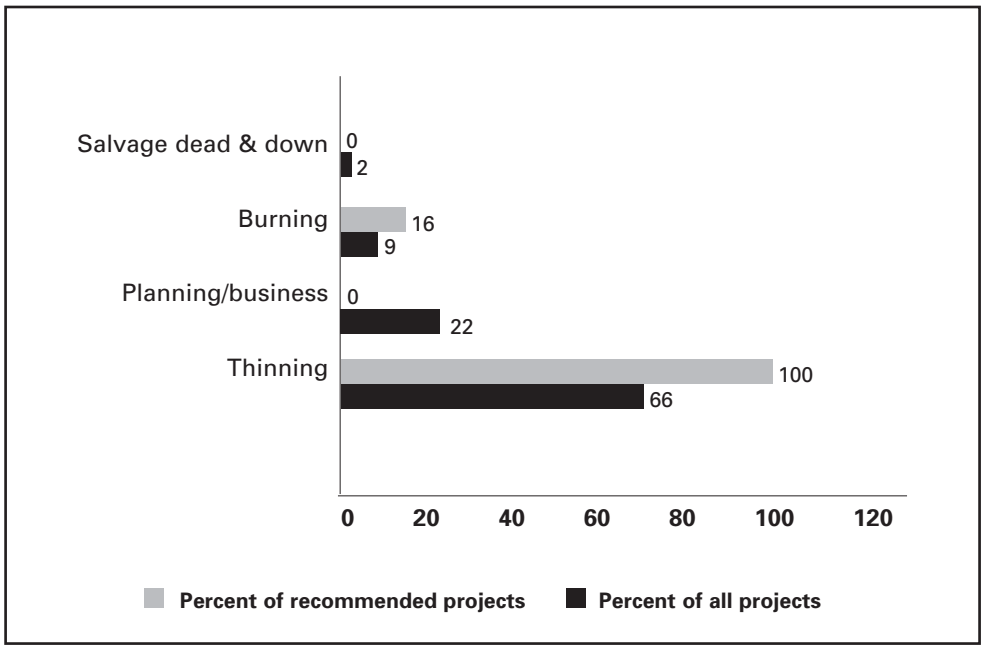


Figure 5. Actions funded by the CFRP program. Some projects have overlapping actions (e.g., thinning and burning)

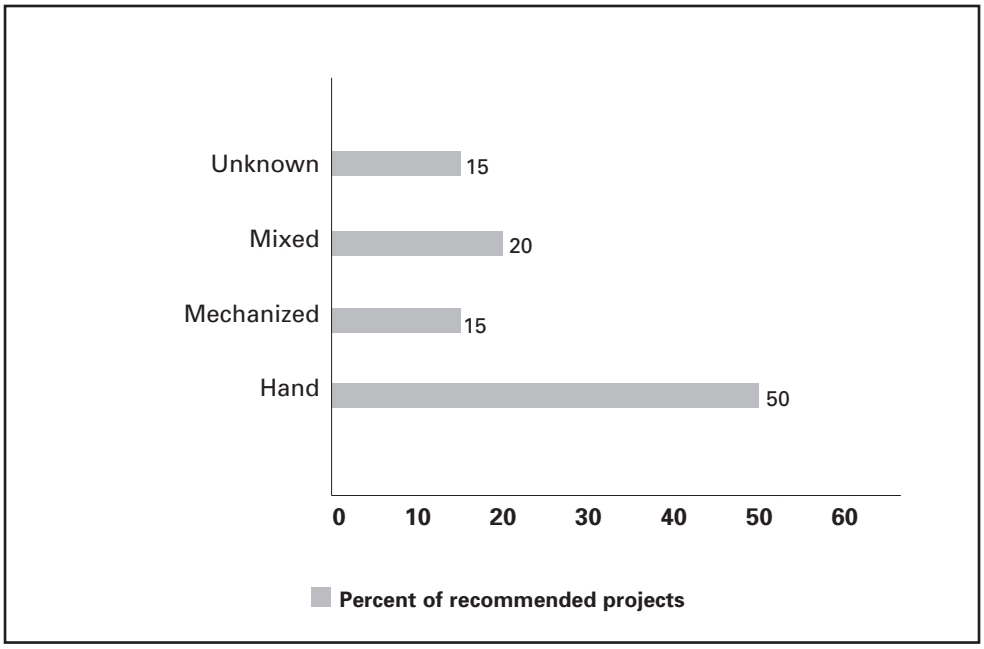


Figure 6. Restoration treatments in projects recommended for long term monitoring

Section 4. Recommendations for Long Term Monitoring: Indicators and Protocols

Monitoring Indicators

As described in Section 1, a committee of more than 40 individuals developed the ecological monitoring guidelines for CFRP. These guidelines included recommendations and methods for assessing 14 indicators. (Appendix 2, from USDA Forest Service 2003). The protocols for monitoring these indicators are described in CFRP Monitoring Handbook 4 (CFRP 2005), and have formed the basis for technical assistance and training of more than 90 grantees to date.

Over time, many involved with monitoring, including land managers, grantees, independent researchers, the ERI multiparty assistance team, and CFRP staff expressed concern over the lack of any standardized indicators and protocols. A 2005 multiparty assessment similarly stated that:

> Currently, a lack of continuity in ecological data among individual CFRP projects makes any generalized assessment of multiple projects difficult. . . If all CFRP projects were to monitor a minimum set of common indicators using comparable monitoring methods, it would be possible to aggregate their monitoring results quantitatively as well as qualitatively (American Forests et al. 2005).

In response to this, the CFRP Monitoring Technical Assistance Team developed a monitoring Short Guide that recommended five ecological indicators for grantees (Moote et al. 2007):

- Density, size, and species of live trees;
- Density and size of dead standing trees;
- Understory cover (grasses, forbs, bare soil, and litter)
- Overstory canopy cover
- Surface fuels.

Our review of 102 projects revealed that the above five Short Guide indicators, as well as photopoints, are the most consistently monitored. These five indicators were also recommended in the final report for the CFRP technical assistance grant. The Technical Assistance Team also strongly recommended that these indicators be measured both before and after the project implementation using reliable and comparable methods. In addition, the report encouraged all CFRP grantees to measure other indicators that might demonstrate trends toward or away from their project goals, with the above list serving as a starting point, not as the limits of CFRP monitoring (ERI 2007).

These recommendations have been the foundation for technical assistance to grantees since 2004. However, as technical assistance and CFRP projects evolve, some parties have suggested that other

indicators, such as crown base height, be added to the short list. As part of our monitoring review, we contacted many individuals, including grantees, monitoring consultants, land managers, university and agency researchers to seek input about recommendations for monitoring indicators (Table 2).

Table 2. Common stakeholder perspectives on monitoring indicators

Grantees	• Allow collaborative selection of indicators and criteria • Keep monitoring costs at or below 10% of project budget • Keep monitoring simple; select indicators that can be monitored by community members without reliance on consultants
Land Management Agencies	• Allow collaborative selection of indicators and criteria • Ensure indicators are identified early so they can be tracked before, during and after project implementation • Make sure that sampling intensity is adequate and data collection reliable
Research	• Indicators should be relevant to the system and restoration objectives • Ensure that the sampling intensity and methodology are at the appropriate scale
Consultants	• Make sure indicators are selected prior to contract bids so that consultants can accurately assess costs at the outset of the project • Keep monitoring simple; even with consultant help, monitoring can become so complicated that community members cannot actively participate in multiparty meetings

We also compiled and compared a list of 35 indicators to determine which indicators are included in CFRP, Forest Service, and BLM protocols (Appendix 3) and analyzed the 20 recommended projects to determine which protocols are being used and how frequently (Figure 7). We found that protocol use in CFRP project monitoring varies considerably, with nearly half of projects using protocals classified in the "other" (non-specified) category and with four projects using more than one protocol (Figure 7).

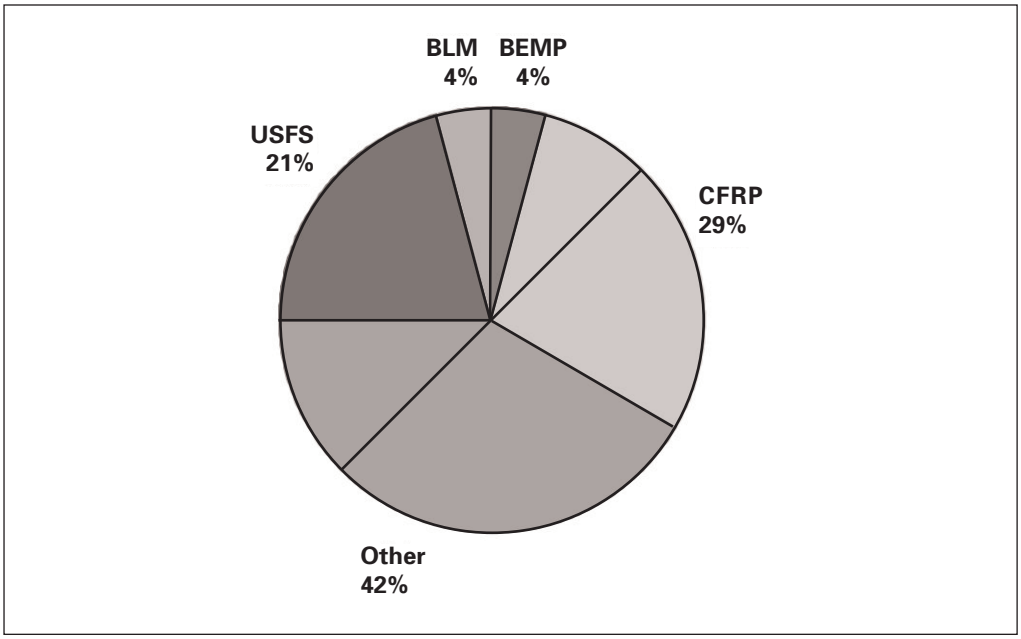


Figure 7. Use of ecological monitoring protocols by land management agencies, as reported by 20 recommended CFRP projects. Four projects use more than one protocol. (Notes: BEMP stands for Bosque Environmental Monitoring Program; BLM protocols are from the Taos field office only)

Protocols developed by CFRP comprised one third of those used, and more than 20% of projects used US Forest Service protocols (Figure 7). Because protocol selection and use is both varied and highly specific to a project's objectives, we believe that maintaining some flexibility in protocol choice is important as long as reasonably standardized monitoring data can be collected. Based on this analysis, recommendations from Ecological Restoration Institute's four years of technical assistance, and multiple stakeholder perspectives, we recommend the following set of indicators for monitoring:

- Canopy cover (%)
- Understory cover (% ground and/or shrub)
- Surface fuels (tons/acre)
- Crown base height (ft)
- Stand structure
  - Tree species
  - Size (DBH, DRC inches)
  - Density (stems/acre live and dead, basal area).

The recommended indicators are easily measured and take into account multiple stakeholder needs yet will allow comparison across land jurisdictions. They differ from the original five only by the addition of (i) shrubs to understory cover and (ii) crown base height as a new indicator.

We strongly recommend that indicator selection remain part of the multiparty process. This means that while we recommend that all grantees monitor the above list of indicators, we also encourage groups to add any indicators that are important for meeting specific project objectives.

Multiple groups have expressed the concern that monitoring remain simple while simultaneously meeting the goals of multiple stakeholders. Many also expressed the imperative that data be reliable. These groups listed standard indicators, standard protocols (where possible), and sufficient training as factors that would increase reliability.

Monitoring Protocols

We also examined the types of monitoring protocols utilized across CFRP projects with the objective of ultimately standardizing the use of protocols. Consultants, land management agencies, and academics all expressed concern about the reliability of monitoring data. Our analysis demonstrated that 25% of the 102 projects analyzed did not have reliable monitoring methods. One way to improve reliability is to recommend standard protocols that can be used by all grantees.

As our analysis demonstrates, projects to date have used a wide variety of protocols (Figure 7), making comparison across the CFRP tenuous. Therefore, our protocol recommendations recognize a variety of factors that ultimately affect protocol selection by multiparty groups:

- Adoption of standardized protocols differs among land management and tenures;
- Groups are required only to monitor project impacts;
- Multi-jurisdictional projects will need to use protocols that facilitate data collection and analysis across these land jurisdictions;
- Monitoring should maintain and build upon the strengths of the existing CFRP monitoring process and protocols; and
- The original intent of CFRP monitoring was to create reliable methods that could be easily used and understood by community groups.

Both community groups and monitoring consultants emphasized the importance of keeping monitoring protocols simple. Simplicity in monitoring helps keep costs down and allows the wide diversity of experience and knowledge held by the multiparty monitoring team to be used in the analysis and interpretation of monitoring data. One of the greatest strengths of the CFRP program is that it encourages the participation of multiple stakeholders and agencies in restoration projects. For this reason, it is essential to maintain the strengths of the multiparty process developed in the early stages of CFRP.

“One of the greatest strengths of the CFRP program is that it encourages the participation of multiple stakeholders and agencies in restoration projects.”

To standardize protocol use, while maintaining some flexibility, we recommend that future grant recipients should select among three standard protocol types – agency, CFRP, or tribal – as determined through the multi-party process. However, we added the following additional criteria to these recommendations:

- Protocols must be appropriate for the indicators recommended;
- Where possible, standardize protocols to facilitate multi-jurisdictional projects; and
- Monitoring data should be presented on a per acre basis with standard error.

These recommendations were reviewed and revised by the TAP as follows:

- Applicants should follow the monitoring protocols of the land management organization where the project will occur.
- If the land management organization does not have a preferred protocol in place, the applicant should use the CFRP protocols identified in the Multiparty Monitoring Short Guide or another statistically appropriate protocol; and that
- Projects which conduct vegetation treatments must at a minimum monitor the following ecological indicators:
  - Canopy cover (%)
  - Understory cover (% ground and/or shrub)
  - Surface fuels (tons/acre)
  - Crown base height (ft)
  - Stand structure
    - Tree species
    - Size (DBH, DRC inches)
    - Density (stems/acre live and dead, basal area).

Additional Recommendations

Reporting. Because of the amount of difficulty we experienced in tracking monitoring data and information retroactively, we have suggested additions to existing grantee reports that will facilitate improved tracking of monitoring in the future (Appendix 4) that will be included in the 2009 Short Guide for Monitoring of CFRP Projects (Moote et al. 2009).

Data Storage. We recommend a data storage system for long term monitoring that allows open access and transparency for all stakeholders. A transparent and easily-accessed data storage system will help all stakeholders, past and present, access and learn from long term CFRP monitoring.

Sharing Results. Many stakeholders wanted the multiparty monitoring process strengthened to guarantee that all members of the multiparty team can receive, review and discuss monitoring data. This last step is critical for adaptive management in that it allows discussion of lessons learned and allows for improvement of future projects and resource management. At the heart of all CFRP monitoring is the need and desire by communities, organizations and land management agencies to learn about the most effective restoration treatments for New Mexican ecosystems, so that these lessons can be carried forward throughout the state. This is increasingly important as more human and financial resources are dedicated to restoration across the state and region.

Section 5: Timeline for long term monitoring

We developed a timeline for monitoring the 20 recommended projects based on each project's start date, followed by 5, 10, and 15 year intervals (Table 3). These intervals are common in ecological monitoring. Because some projects have already passed the 5-year post treatment monitoring year, they will need to be monitored as soon as possible, and the timeline adjusted accordingly. In addition, some projects' treatment start date may have varied significantly from the grant award date. In these cases, subsequent intervals may also need to be modified.

Table 3. Timeline for Long Term Monitoring

Project (Grant #, and Name)	Treatment Start Date	National Forest Management Unit	5 Year Post	10 Year Post	15 Year Post
16-01 MRGCD Bosque	2003	Cibola NF	2008	2013	2018
06-02 San Juan Bosque	2003	Santa Fe NF	2008	2013	2018
03-01 La Jicarita	2005	Carson NF	2010	2015	2020
36-04 Turkey Springs Ruidoso	2005	Lincoln NF	2010	2015	2020
27-04 Santa Fe FD WUI	2005	Santa Fe NF	2010	2015	2020
28-05 Ensenada	2006	Carson NF	2011	2016	2021
01-05 Bluewater	2006	Cibola NF	2011	2016	2021
21-04 Sierra SWCD Black Range	2006	Gila NF	2011	2016	2021
39-05 SBS II - Cedar Creek	2006	Lincoln NF	2011	2016	2021
11-01 LTRR Monument Canyon	2006	Santa Fe NF	2011	2016	2021
02-05 P&M Thunderbird	2007	Cibola NF	2012	2017	2022
05-07 Santa Ana Juniper II	2007	Cibola NF	2012	2017	2022
13-07 Ruidoso Schools	2007	Lincoln NF	2012	2017	2022

Project (Grant #, and Name)	Treatment Start Date	National Forest Management Unit	5 Year Post	10 Year Post	15 Year Post
33-05 Taos Pueblo	2008	Carson NF	2013	2018	2023
16-07 FG III Santa Cruz/Embudo	2008	Carson NF	2013	2018	2023
22-04 Gallinas - Tierra y Montes	2008	Santa Fe NF	2013	2018	2023
22-07 Barela Timber	2008	Santa Fe NF	2013	2018	2023
25-07 Santa Clara Pueblo - Beaver	2008	Santa Fe NF	2013	2018	2023
28-07 Santa Domingo Forest to Farm	2008	Santa Fe NF	2013	2018	2023
29-07 SWPT Ocate State Lands	2008	Santa Fe NF	2013	2018	2023

We also charted the monitoring process over the next 15 years, to better understand the number of projects that would need to be monitored in any one year. As shown below, monitoring peaks in 2013 and 2018, with 11 projects requiring monitoring in these years. Otherwise, the number of projects to monitor in any one year was under 10 (Figure 8).

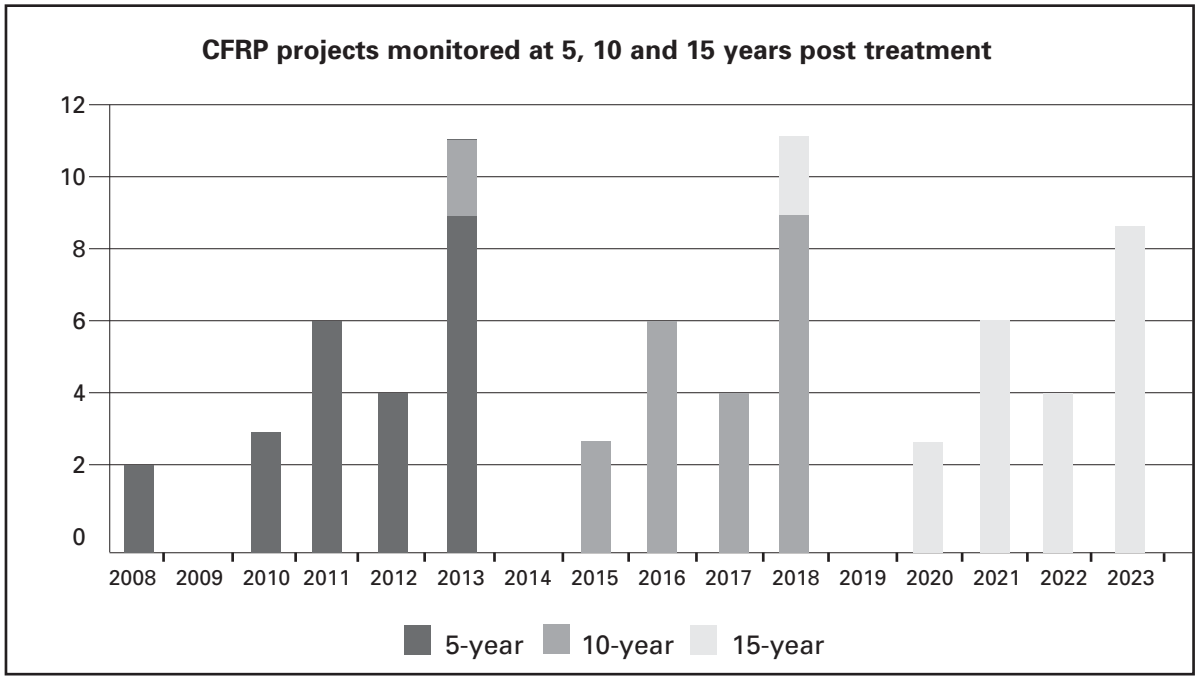


Figure 8. Long term monitoring intervals

Next Steps

In the process of developing these recommendations, we identified a number of issues that will need to be addressed in the early stages of long term monitoring, including:

- Develop a process for identifying new CFRP projects that will be included in long term monitoring efforts
- Determine a process for engaging the original CFRP project partners in long term monitoring efforts, at the annual workshop or other venue, to ensure at a minimum the inclusion of:
  - o Land management agencies
  - o Non-profit organizations that have been engaged in CFRP monitoring and project implementation, such as the Forest Guild and The Nature Conservancy
- Address potential sovereignty issues for long term monitoring on tribal land
- Develop procedures for data storage, including database format and language, and identify who will be able to administer the database
- Work with land management agencies to determine the potential role of remote sensing in long term monitoring.

Conclusion

We reviewed the 102 CFRP projects funded through 2007. Based on our review, we have recommended 20 projects for long term monitoring. These projects monitored a minimum of five indicators and had highly reliable monitoring data. The recommended projects were also located across a diversity of forest types and land tenures, and provided a balanced geographical distribution throughout the state. We also recommend that all future CFRP grantees follow a standard set of indicators, including:

- Canopy cover (%)
- Understory cover (% ground and/or shrub)
- Surface fuels (tons/acre)
- Crown base height (ft)
- Stand structure
  - Tree species
  - Size (DBH, DRC inches)
  - Density (stems/acre live and dead, basal area).

To monitor these ecological indicators, we recommend that grantees follow the standard agency, tribal or CFRP protocols. Throughout this paper, we have emphasized the importance of the multi-party process in determining specific project indicators and protocols. We have also underscored the need, expressed by both community groups and monitoring consultants, to balance simplicity in monitoring with consistency, relevancy, and comparability across projects.

Because of difficulties that we experienced while tracking monitoring data and information retroactively, we suggest making additions to existing grantee reports that will facilitate improved tracking of monitoring in the future. Additionally, we recommend the development of a transparent and accessible data storage system for long term monitoring data.

Many stakeholders supported strengthening the multiparty monitoring process so that all members of the team have the opportunity to review and discuss the monitoring data. This step is critical for adaptive management as it facilitates discussions of lessons learned and contributes to improving future projects and resource management in general. At the heart of all CFRP monitoring is the goal of helping communities, organizations and land management agencies to learn about the most effective methods of forest restoration. It is critical that the lessons provided by the CFRP program be shared among land managers throughout New Mexico as the amount of human and financial resources dedicated to forest restoration continues to grow across the Southwestern United States.

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Appendix 1. Initial 30 CFRP projects selected for consideration for 15-year monitoring based upon the reliability of ecological monitoring data and other criteria including forest type, treatment and land tenure. The numbers in parentheses represent the total number of projects administered by the National Forest.

Carson (20)	Cibola (18)	Gila (13)	Lincoln (7)	Santa Fe (33)
09-03 Questa	16-01 MRGCD Bosque	46-01 Sierra SWCD	20-01 Ruidoso - Eagle Creek	03-01 La Jicarta
28-05 Ensenada	43-01 Las Humanas	21-04 Gila Woodnet	36-04 Turkey Springs Ruidoso	11-01 LTRR - Monument Canyon
33-05 Taos Pueblo	11-04 Zuni II		39-05 SBS II - Cedar Creek	06-02 San Juan - Bosque
14-06 RMYC - Largo Canyon	01-05 Bluewater		13-07 Ruidoso Schools	27-03 Valles Caldera - The Nature Conservancy
16-07 Santa Cruz - Embudo	02-05 P&M - Thunderbird			22-04 Gallinas - Tierra y Montes
17-07 Kuykendall TP WUI	05-07 Santa Ana Juniper II			23-04 Pecos - alle Grande II
				27-04 Santa Fe Fire Department - WUI
				22-05 NM Recycling
				11-06 Coyote Road Closure
				22-07 Barela Timber
				25-07 Santa Clara Pueblo
				28-07 Ohkay Owingeh

Appendix 2. Indicators and Sampling Methods Recommended by 2003 Committee

Sampling Method	Indicator
Point Count	Photo points
Transect-Based Sampling	Landscape openings
	Bird species abundance and composition
	Butterfly species abundance and composition
	Seedling density
	Surface Fuels
	Canopy Cover
	Riparian plant community structure
Plot-Based Sampling	Density, species and size of live trees
	Density and size of dead trees
	Height from ground to tree crown
	Understory plant species composition
	Understory cover
	Extent of bare soil

Appendix 3. Ecological indicators monitored by the CFRP, Forest Service and BLM. An "X" in a column indicates that the indicator is monitored by that Agency.

Ecological Indicator	CFRP Handbook 4	USFS Stand Exam Level II	BLM Taos Office
Live and dead tree species	X	X	X
Live and dead tree size	X	X	X
Live and dead tree density	X	X	X
Sapling species	X	X	X
Sapling size			X
Sapling density	X	X	X
Seedling species	X	X	X
Seedling size (to 0.1 cm)			X
Seedling density	X	X	X
Crown base height of live trees	X	X	
Tree height	X	X	
Basal area		X	
Crown diameter (mean)		X	
Crown light exposure		X	
Crown vigor (saplings)		X	
Damage (1-3)		X	
Foliage transparency		X	
Live crown ratio		X	
Severity (damage)		X	
Cause of death		X	
Crown density		X	
Crown dieback		X	
Crown position		X	
Description (tree notes)		X	
Location (damage 1-3)		X	
Tree age at DBH		X	

Ecological Indicator	CFRP Handbook 4	USFS Stand Exam Level II	BLM Taos Office
Canopy cover percent	X		
Seedling and sapling cover percent (<2 cm)	X		
Ground cover percent	X		X
Surface fuels	X	X	
Landscape openings	X		
Bird species and abundance	X		
Butterfly species and abundance	X		
Classification of riparian plant community	X		
Understory plant species composition	X		

Appendix 4. Revised Grantee Report

1) Name of Grantee: _____

2) Date of Report: _____

3) Grant Number: _____

4) Location of Work: _____
(Description of location, Township/Range/Section and map if appropriate (i.e. USGS topo Map,etc)

5) Number of people employed as a result of the grant (new employees): _____

6) Description of work accomplished: _____
(such as: thinning, brochure/signs, planting, purchase of equipment, product development, fire plan)

7) Forest type(s) or ecosystems working in (please check all that apply):
☐ Ponderosa Pine
☐ Pinyon Juniper
☐ Mixed Conifer
☐ Bosque
☐ Riparian
☐ Other (please specify): _____

8) Types of treatments employed (check all that apply):
☐ Lop and scatter
☐ Chipping
☐ Piling and Burning
☐ Broadcast Burning
☐ Other (please specify): _____

8) Number of units/items accomplished:_____
(i.e. # of acres thinned, # of brochures printed, # of signs produced, etc)

9) Monitoring Accomplishments (please check all that apply):
☐ Multiparty Meeting(s) held
☐ Monitoring Plan developed
☐ Baseline (pre-treatment) data collected
☐ Post-treatment data collected

10) Please check the indicators you are monitoring:

- ☐ Live and dead tree size, species and density
- ☐ Overstory canopy cover
- ☐ Understory cover (grasses, forbs, shrubs, bare soil, rock)
- ☐ Amount of downed woody surface fuel
- ☐ Crown base height
- ☐ Understory plant species composition
- ☐ Seedling density
- ☐ Wildlife
- ☐ Water quality
- ☐ Photo points
- ☐ Other (please specify): _____

11) Narrative Description of Accomplishment:

(Please review your grant proposal and report on status and accomplishments for "each" objective of your project, include information on development or implementation of your monitoring plan. Tell us what you did, how the money was spent, etc. Attach any copies of items produced if applicable – brochures, newsletters, pictures of signs, before and after pictures, etc.)

12) Final Report:

At end of grant period for grant close-out.
Tie your accomplishments to your project objectives as stated in your proposal (be specific). Was success achieved? Why or why not.

CFRP Grant Recipients: The final report is to include a multiparty assessment to-(A) identify both the existing ecological condition of the proposed project area and the desired future condition; and (B) report, upon project completion, on the positive or negative impact and effectiveness of the project including improvements in local management skills and on the ground results.

New Mexico Forest and Watershed Restoration Institute

The New Mexico Forest and Watershed Restoration Institute at New Mexico Highlands University is dedicated to providing state-of-the-art information about forest and watershed restoration to the public, federal and state agencies, tribes, and private landowners in New Mexico. To accomplish this, the Institute collaborates with citizen stakeholders, academic institutions, NGOs, and professional natural resources managers to establish a consensus concerning prescriptions and monitoring protocols for use in the restoration of forests and watersheds in an ecologically, socially, and economically sound manner. Through research and collaboration, the Institute promotes ecological restoration and forest management efforts in ways that 1) will keep New Mexican homes and property safe from wildfire, 2) will lead to a more efficient recharge of New Mexican watersheds, and 3) will provide local communities with employment and educational opportunities.