

# Long-term CFRP Monitoring: 2009-2011

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Long-term monitoring is written in to the legislation that created the CFRP. The bill that became Public Law No. 106-393, the Community Forest Restoration Act, states that one of its purposes is to develop, demonstrate, and evaluate ecologically sound forest restoration techniques. Section 607, Monitoring and Evaluation, states:

The Secretary shall establish a multiparty monitoring and evaluation process in order to assess the cumulative accomplishments or adverse impacts of the Collaborative Forest Restoration Program. The Secretary shall include any interested individual or organization in the monitoring and evaluation process. The Secretary also shall conduct a monitoring program to assess the short- and long-term ecological effects of the restoration treatments, if any, for a minimum of 15 years.

The framework for the long-term monitoring was laid out in the document by Derr et al (2008). That document had two principle action items. First, it contained a list of core ecological indicators that were highly recommended for each project to monitor:

- 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).

Second, a two-tiered selection was imposed on all CFRP projects that had a treatment start date of 2008 or earlier. The first round looked at the following categories:

- Forest type (e.g., ponderosa pine, piñon-juniper, mixed conifer, bosque)
- Forest Service management unit (as a proxy for geographic location)
- Project actions (e.g., thinning, planning, burning, etc.)
- Land jurisdiction (e.g., Forest Service, Bureau of Land Management, tribal, land grant)

- Treatment type (e.g., hand or mechanical thinning, burning)
- Ecological indicators monitored, and
- Reliability of ecological monitoring.

The first round produced a list of 30 projects that were more closely evaluated based upon the following five criteria:

- Forest type
- Treatment type
- Land tenure
- Unique project features (e.g., beaver restoration, mulch treatments, road closure)
- Coordinator priorities.

After a review of completed and on-going CFRP projects, 20 selected projects were recommended to be monitored at five-year intervals for 15 years after on-the-ground work began (Table 1).

**Table 1.** Final 20 projects recommended for 15-year monitoring by forest type. Numbers in parentheses indicate the number of ecological indicators monitored; these are not necessarily the same indicators listed in this text.

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

The timeline for monitoring the 20 recommended projects based on each project's start date, followed by 5, 10, and 15 year intervals, is shown in Table 2.

**Table 2.** 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
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

**Project summaries - numbers**

For reasons which are explained elsewhere, the MRGCD Bosque project was not remeasured. The remaining nine projects scheduled for 5-year monitoring have been remeasured. They are listed here (Table 3).

**Table 3.** Descriptions of CFRP projects scheduled for remeasurement at 5 years since treatment. Those projects remeasured during 2011, indicated here by a \*, have not yet had the 2011 data analyzed.

Project (Grant #, and Name)	Location	Grantee	Treatment Start Date	5 Year Post	Acres	Highlights	Concerns
16-01 MRGCD Bosque	S of Abq	MRGCD	2003	Not measured	350		Initial information and measurements treated as proprietary, unavailable
06-02 San Juan Bosque	Ohkay-Owingeh	Pueblo of San Juan	2003	Fall 2010	210	Part of larger, contiguous restoration	
03-01 La Jicarita	Walker Flats, Mora County	La Jicarita Enterprise Community	2005	2010	578	Part of larger, contiguous restoration	Could not use coordinates for initial plot centers
36-04 Turkey Springs Canyon	S of Village of Ruidoso Downs	South Central Mountain RC&D	2005	2010	249		maintenance
27-04 Santa Fe FD WUI	Arroyo Hondo Open Space	Santa Fe County FD	2005	2010	640	Initial measures part of NMSU research	
28-05 Ensenada *	N of Cañon Plaza	Alfonso Chacon & Sons	2006	2011	260		
01-05 Bluewater WUI *	S of Bluewater Lake	The Forest Guild	2006	2011	1,500	Restoration of historic treeless areas	Transects close together, uneven lengths
21-04 Sierra SWCD Black Range *	W of Poverty Creek	Sierra S&WCD	2006	2011	200	Initial measures part of ERI/NAU research; Rx fire	
39-05 Cedar Creek Break *	Ruidoso	Sherry Barrow Strategies	2006	2011	252	Initial monitoring well-executed	Could not find coordinates for initial plot centers
11-01 Monument Canyon *	NE of Jemez Springs	Laboratory of Tree-Ring Research, U of Ariz	2006	2011	250	Some plots intensively measured by U of A; Rx fire planned	Had problems with coordinates for initial plot centers

**Table 4.** Ecological indicators – pre-treatment.

Project (Grant #, and Name)	Type	Canopy Cover %	Understory Cover %	Surface fuels tons/acre	Crown base ht ft	Avg DBH inches	Trees per acre	Basal area
06-02 San Juan Bosque	Bosque	67	21	-	-	8.6	250	-
03-01 La Jicarita	Mixed conifer	94	10.3	3.7 – 4.2	-	10.51	880	135
36-04 Turkey Springs Canyon	Ponderosa and PJ	-	-	-	-	-	-	-
27-04 Santa Fe FD WUI <sup>1</sup>	PJ	-	29	-	-	-	242	-
Cut dead		-	18.3	-	-	-	224	-
Leave mid-size		-	20.6	-	-	-	284	-
Remove mid-size		-	17.5	-	-	-	216	-
Chip		-	12.5	-	-	-	284	-
Compost		-	33.9	-	-	-	224	-
Not treated		-	38.0	-	-	-	220	-
28-05 Ensenada <sup>2</sup>	Ponderosa, mixed conifer							
Ponderosa 2	Pipo	68	12	15.3	26.5	9.0	439	163
Ponderosa 3	Pipo	56	na	na	na	9.4	395	75
Meadow 2	meadow	49	77	na	na	10.8	166	79
Mixed Conifer 1	mixed conifer	58	Na	26.9	14.2	9.4	454	na
Aspen 1	Aspen	Na	24.8	na	na	8.3	279	84
01-05 Bluewater WUI <sup>3</sup>								
Phase 1	PJ	5	19.5	4.8	-	6.6	4	0.97
Phase 2 <sup>4</sup>	PJ, Ponderosa	8	34.5	7.1	-	6.4	157	2.2
Upland	meadow	19.2	19.9	0.2	-	6.7	323	na
Rice Park	meadow	8	47.9	2.7	-	10.2	182	na

<sup>1</sup> For pre- and post-treatment on Santa Fe FD WUI, *cover* is sum of grass, forb, and 0-1 m tall woody vegetation; *trees per acre* is the sum of all live and dead piñon and juniper. The only dead juniper on the plots was in the post-treatment Not Treated.

<sup>2</sup> Ensenada average DBH does not include saplings.

<sup>3</sup> Bluewater average DBH does not include saplings.

<sup>4</sup> Pre-treatment Bluewater Phase 2 possibly includes values from the ponderosa pine unit Twin Springs.

**Table 5.** Ecological indicators – post-treatment

Project (Grant #, and Name)	Type	Canopy Cover %	Understory Cover %	Surface fuels tons/acre	Crown base ht ft	Avg DBH inches	Trees per acre	Basal area
06-02 San Juan Bosque	Bosque	41-64	25	23.2	-	23	105	-
03-01 La Jicarita	Mixed conifer	44-57	20.1	4.1-5.1	-	12.1	-	107
36-04 Turkey Springs Canyon	Ponderosa and PJ	-	-	-	-	-	-	-
27-04 Santa Fe FD WUI <sup>1</sup>	PJ							
Cut dead		-	31.4	-	-	-	128	-
Leave mid-size		-	34.3	-	-	-	100	-
Remove mid-size		-	22.0	-	-	-	76	-
Chip		-	15.8	-	-	-	124	-
Compost		-	21.2	-	-	-	80	-
Not treated		-	44.1	-	-	-	168	-
28-05 Ensenada <sup>2</sup>								
Ponderosa 2	Pipo	40	10	36.7	29.2	10.7	264	128
Ponderosa 3	Pipo	24	na	20	na	11	178	178
Meadow 2	meadow	29	29.1	14.5	na	10.7	117	52
Mixed Conifer 1	mixed con	45	na	23.5	22.2	11.6	252	na
Aspen 1	aspen	na	8.8	na	na	8.7	253	84
01-05 Bluewater WUI <sup>3</sup>								
Phase 1	PJ	0	29.3	4.6	-	0	0	0
Phase 2	PJ	0	39.8	13.7	-	0	0	0
Upland meadow	meadow	4.5	22.1	5.3	-	8.1	50.0	na
Rice Park	meadow	4	30.5	3.4	-	15.3	39	na

<sup>1</sup> For pre- and post-treatment on Santa Fe FD WUI, *cover* is sum of grass, forb, and 0-1 m tall woody vegetation; *trees per acre* is the sum of all live and dead piñon and juniper. The only dead juniper on the plots was in the post-treatment Not Treated.

<sup>2</sup> Ensenada average DBH does not include saplings.

<sup>3</sup> Bluewater average DBH does not include saplings.

**Table 6.** Ecological indicators – 5 years post-treatment. Crown base height was collected but has not been analyzed. Diameters follow Region 3 standards for forest (breast height) or woodland (root collar) species. Those projects remeasured during 2011, indicated here by a \*, have not yet had the 2011 data analyzed.

Project (Grant #, and Name)	Type	Canopy Cover %	Understory Cover %	Surface fuels tons/acre	Crown base ht ft	QMD inches	Trees per acre	Basal area
06-02 San Juan Bosque	Bosque	53	29	17	na	21.2	39	92
03-01 La Jicarita	Mixed conifer							
Corrales		26	0	19.3	na	12.4	260	42
Walker Flats		45	9	11.9	na	15.3	172	79
Encinal		39	9	10.7	na	14.8	147	82
36-04 Turkey Springs Canyon								
W of FR119	Pipo	35	17	28	na	15.9	92	49
E of FR119	PJ	12	27	30	na	12.3	52	23
27-04 Santa Fe FD WUI	PJ (diam is DRC)							
Cut dead		3	4	12	na	13.3	204	40
Leave mid-size		5	2	10	na	12.3	108	27
Remove mid-size		22	3	5	na	12.6	104	32
Chip		15	2	6	na	13.7	134	38
Compost		12	2	10	na	13.3	124	33
Not treated		12	0	8	na	15.2	230	46
28-05 Ensenada *	various	na	na	na	na	na	na	na
01-05 Bluewater WUI*	PJ, meadow	na	na	na	na	na	na	na
21-04 Sierra SWCD Black Range *	ponderosa	na	na	na	na	na	200	na
39-05 Cedar Creek Break *	Ponderosa, PJ	na	na	na	na	na	252	na
11-01 Monument Canyon *	ponderosa	na	na	na	na	na	na	na

## Project summaries - descriptions

16-01 MRGCD Bosque – FWRI attempted for more than a year to obtain the final report. The grantee and cooperators never shared shapefiles of treated areas. Pre-and post-treatment monitoring appears to have been done with money other than CFRP, and the resulting data are considered to be unpublished research and not subject to release. The agency that did the initial measurements requested funds from us to do the five-year monitoring; we never responded to that request.

06-02 San Juan Bosque – This project is part of a bigger effort that has restored most of the Ohkay Owingeh bosque along the Rio Grande. In this case, as is true of Rio Grande bosque in general, restoration is synonymous with the removal of non-native phreatophytes, salt cedar and Russian olive. Judging from the few remaining thickets on the margins, the area was almost impenetrable before restoration. The project area has high numbers of New Mexico olive (*Foresteria neomexicana*) in the understory. This project is a success, with the only qualification being the lack of young cottonwood, a problem that has more to do with the management of the river than with the Pueblo's capacity to manage the bosque.

This project was remeasured during the winter of 2010-2011, two years behind schedule. This delay was due principally to the necessity of clear permission before our crew could enter on to Pueblo land. The Pueblo cooperated fully with us, but the process took a long time. The final report was consulted and those data are incorporated here.

03-01 La Jicarita – This project was part of the larger Walker Flats restoration. The original grantee, La Jicarita Enterprise Community, had disbanded by the time remeasurement was to take place. However, NMSU had done the original monitoring as part of a research study, and they shared their data. The final project report was consulted, but it is the report of a research study that answered different questions than what constitute standard monitoring. Their plot design was different enough from our protocols that we established a new plot grid across the project area. Restoration goals for mixed conifer are not as well defined as they are for ponderosa pine, but judging from the reduction in stand density, the restoration goal of reducing the risk of catastrophic wildfire was achieved.

36-04 Turkey Springs Canyon – The original monitoring on this project was done using transects. The final project report was made available and consulted, but the report was principally photographs and had few relevant numbers. We established the grid of plot centers using our protocols.

This project had two distinct areas: A ponderosa pine stand along FR 119, and a piñon-juniper stand on a south-facing slope to the east of FR 119. Based on the residual stand, the restoration of this PJ stand consisted of felling and lop-and-scatter of all trees except the biggest piñon. The PJ stand has a significant oak component, covering about 40% of the surface area. When we measured the area in early August 2010, the oak was 3' to 4' tall, just under the lower limit to be measured.

Measurement challenges aside, the existing stand illustrates the need for maintenance after initial restoration. The combination of fairly high levels of 100- and 1000-hr fuels on the ground, and a growing stand of oak, points out a rapidly closing window to safely and cheaply do the necessary maintenance on this area. If this area had been broadcast burned as soon as possible after the mechanical thinning, much of the down woody debris would have burned. Such a fire would



have had little long-term effect on the oak. Now, we are faced with an unusual combination of a lot of oak that continues to increase in volume and a lot of down woody debris that is not breaking down on this south-facing hillside. The fuels are different than they were before treatment, but the risk of a stand-replacing fire is very real. In any event, the fuels on this slope are unusual enough that a specialist in fire behavior needs to look at it the site before any fire is ignited.

27-04 Santa Fe FD WUI – Our remeasurement corresponds to the thinning in what is now the Arroyo Hondo Open Space of Santa Fe County. The pre- and post-treatment measurements were done by NMSU as part of a thinning study. Both pre- and post-treatment reports were made available to us, and observations incorporated into this document. The initial measurements were made on circular plots, not transects, and so were completely compatible with our standard protocols. In almost all cases, we were able to locate the pin identifying the original plot center, and take plots on the same plot. Even though not every acre was treated (one of the experimental units was a no-treatment Control), this woodland should be considered as restored.

28-05 Ensenada – The final project report was consulted and data incorporated into this document. This final report is possibly the best one we have seen. However, data were not collected uniformly across the project area. Five different treatment units were measured. Usually, trees per acre were “adult” trees, saplings, and snags, but seedlings were included in that count in one of the units (Meadow II); seedlings are excluded in trees per acre in the pre-and post-treatment tables in this report (Tables 4 and 5). This is the only report to date that reports height to crown base, but this value is reported for only two of the units. Canopy cover, understory cover, surface fuel loading, and basal area were not always reported. Average stand diameter does not seem to be uniformly calculated, e.g., snag diameters are sometimes reported separately, and other times not mentioned.

Transects were used in initial monitoring. Four areas were monitored: Ponderosa III, Aspen 1, Mixed Conifer 1, Ponderosa II, and Meadow II. We imposed our standard plot grid on the project area. Individual aspen stems appear to have been thinned in the Aspen unit, and some white fir left, leading us to question the goals of that portion of the project.

01-05 Bluewater WUI – The areas restored under this project were mainly historic open areas that had been planted 30-40 years ago under misguided public pressure. The restoration consisted of felling the trees and, in most of the area, windrowing the slash. Consistent with the desired conditions, many of the plots had no trees, and most had only a few. The initial monitoring was with transects, and the transects were of unequal lengths and tended to be clumped.

The final report was made available and data incorporated into this document. Basal area was not reported in two units where it was most appropriate. The diameter for the PJ units was reported as DBH, not DRC as is standard with the Forest Service Region 3. We took plots at the mid-point of the transects, and because most of the trees had been removed, ignored the potential problem of the monitoring plots occurring in close together. The treated areas of this project meet the desired conditions for restoration.

21-04 Sierra SWCD Black Range – This area is partially PJ and partially Ponderosa pine. ERI helped the grantee with the initial layout and monitoring. The final project report was not found,

although it possibly may exist at ERI. The grantee and other cooperators were very cooperative, but this project has seen extensive turnover of key staff.

FWRI remeasured the treated area using the original plot centers. This was the first project that we remeasured that used witness trees to help locate plot center. A wildfire passed through part of the area since the project was completed, burning in a historically appropriate manner. The project area seems restored.

39-05 Cedar Creek Break – This area is immediately north of the Smokey Bear District Office, and surrounded on three sides by residential neighborhoods. It is a transition between PJ and Ponderosa pine. The grantee and the District were cooperative, but the final project report could not be located. Judging by maps, the initial monitoring was good, with a good distribution of plots. However, as in the case of the final report, changing personnel meant the coordinates for the initial plots could not be located, and we imposed our standard plot grid on the project area. Restoration is successful, with some plots in the north showing need for Gambel oak maintenance.

11-01 Monument Canyon – This project area has a long history as a natural area. Trees were not allowed to be cut and fire was excluded for 50 years until 2006, when part of the area was restored using CFRP funds and other. (I do not know how no one was killed during the mechanical thinning; the large (>20” dbh snags) were retained, numbering 2 or 3 per acre, and many of them severely lean.) After the mechanical thinning, regeneration ranged as high as 50,000 ponderosa seedlings per acre. The area is scheduled for prescribed burning in September 2011. FWRI has not seen a final project report, but since the research in the area is on-going, it may have never been written. The grantee continues to take detailed measurements of this project, but only of a limited number of plots. We planned to measure the remainder of the original grid, using the original plot centers and measuring at least some of the same trees. (The original plots were square.) However, when we finished our field work we realized our projection of the original plots had a systematic error. Thus, we imposed our standard plot grid on the project area, rather than measuring the same plots. In terms of structure, the treated area is restored, but the regeneration is creating a new dog-haired stand. The scheduled prescribed fire should kill much of the regeneration back to a more desired level.

## Looking ahead

Now that we have gathered some experience with project re-measurement, we have identified several challenges to the long-term monitoring project as currently designed:

- Communications with key people associated with specific sites is often unreliable (e.g., unreturned phone calls, lack of or unavailable pre-treatment information), making it difficult to impossible (for some sites) to schedule re-measurement.
- A common opinion (but not universal) among grantees is that these projects are completed. They have moved on to other work, and are not enthusiastic about long-term monitoring.
- While the working group that identified projects for long-term monitoring was competent and dedicated, information that has surfaced since then has raised questions as to whether some of the sites originally selected are well suited for re-measurement. See comment under “Potential problems . . .” and “Observations” below.

- Questions about long-term storage and management of monitoring data – including available budgetary, technological, and human resource capacity – have yet to be answered.
- A problem unique to this year and to preparation of this report was the fire closures during June and July, preventing us from accessing two of the project areas (Cedar Creek and Monument Canyon) during much of the time we had a field crew. Five-year remeasurement data from these areas have yet to be entered into FFI for analysis.

Possible solutions include:

- Maintaining the option to delete an already targeted re-measurement site when treatment data, project area descriptions, or previously accomplished monitoring data are insufficient or unavailable, and, where possible, substituting a more appropriate site.
- Before project funding and initiation, making clear to grantees their responsibilities related to follow up with long-term monitoring – including record keeping, record availability, and communication with re-measurement personnel.
- Requiring a project contact person to provide data/information to re-measurement personnel immediately following the pre- and post-treatment inventories.

Potential problems with specific projects already selected for long-term monitoring (Table 1):

- 05-07 Santa Ana Juniper II: When we realized we were not going to be able to measure the MRGCD Bosque project, we looked for a bosque project to replace it. Santa Ana Pueblo had a candidate project (09-05 Santa Ana Rio Grande Restoration Project), but when we contacted them, we were told that given the makeup of the current tribal council, we would not have access to past data, nor be given permission to enter Pueblo lands to remeasure the project. Pueblo government changes annually, so that position may change by the time this project is to be measured in 2012. However, of the remaining 10 CFRP projects to be measured, four of them are on Pueblo lands. We may have trouble these projects; in any event, access will be subject to approval on a case-by-case basis.
- 25-07 Santa Clara Pueblo – Beaver: Santa Clara was hard-hit by the Las Conchas fire. Even if this project area did not burn over, it undoubtedly has been impacted by the subsequent flooding.
- 22-07 Barela Timber: This CFRP project had problems from the beginning, and no on-the-ground work appears to have been done since some initial thinning on Johnson’s Mesa. This project seemed to be a case of the Forest Service District trying to use CFRP to establish a shaded fuelbreak in mixed conifer, a goal that was at odds with the wishes of the grantee, who subsequently did a poor job on the wood removal. We did the initial monitoring, but this project no longer meets the selection criteria of project action nor treatment type, and we recommend it be dropped and replaced with something more appropriate.

Observations:

- To date, not enough information has been collected to make meaningful comparisons between projects within the same forest or woodland type. Due to sample size and site,

prescription, and grantee differences, head-to-head comparisons will probably never be valid. Trends, however, should be able to be detected. Most likely, the longevity of a treatment should be able to be determined, at least relative to another treatment on a similar site.

- No occasion is apparent where monitoring data were used to make adaptive management decisions. No doubt, visits to a project area resulted in modifications within the parameters of the prescription from year-to-year and even from project-to-project by the same grantee, but these gut-level changes do not show up on data sheets. FWRI has experience with an Alamo Navajo project where initial measurements led to modification of the prescription, but that project is not part of this list. Finally, the possibility exists that adaptive management modifications might not be reported for fear of appearing to not fulfill approved work plans.
- The Ensenada final report specifies targets for indicators, something that was not noticed elsewhere and is commendable.
- The average DBH or DRC given in every pre-and post-treatment report appears to be an arithmetic mean. Typically in forestry, the average diameter of a stand is expressed as a quadratic mean. This calculation gives the larger diameter trees more weight, so the quadratic mean is always larger than the arithmetic mean. The quadratic mean diameter is also equal to the diameter of the tree of average basal area, a useful observation that can not be derived from the arithmetic mean. FFI returns quadratic means for diameter, as are reported for our five-year measures in Table 5.
- Conversations about long-term CFRP monitoring have carried the assumption that projects begun after 2008 would be selected and added to the original list of 20. The same criteria used for the 2008 selection process can be used to select the additional projects, but the scrutiny should be stricter than in 2008. On the other hand, the quality of CFRP projects has improved every year, and a possible corollary is that the quality of monitoring and maintaining the monitoring data also has improved. Thus, the percentage of projects suitable for long-term monitoring may be higher than it was in 2008.

## Reference

Tori Derr, Deborah McGrath, Vicky Estrada, Eytan Krasilovsky and Zander Evans. 2008. Monitoring the Long Term Ecological Impacts of New Mexico's Collaborative Forest Restoration Program. Working Paper 5. New Mexico Forest and Watershed Restoration Institute.