New Mexico Forest Prescriptions

Case studies from around the state

New Mexico Forest and Watershed Restoration Institute

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Introduction

This collection of case studies that highlights forest prescriptions and their outcomes throughout New Mexico was one of the most requested items derived from a series of stakeholder meetings hosted by the New Mexico Forest and Watershed Restoration Institute in 2005. The idea was also listed as a stakeholder request during the 2005 Town Hall that addressed the New Mexico Forest and Watershed Health Plan and the mission of the NMFWRI. Finally, the federal authorizing legislation for the NMFWRI, the Southwest Forest Health and Wildfire Prevention Act of 2004 (PL 108-317), directed the NMFWRI to compile and transfer knowledge of forest prescriptions to our stakeholders across the state.

The NMFWRI would like to acknowledge the publication of "Forest restoration and fuel reduction projects in Southwest ponderosa pine: A comparison of sites and treatments" by Martha Schumann, Forest Guild Working Paper 9 (June 2004). This paper helped guide our thinking about the format for this web-based collection of case studies.

For further information or comments regarding this collection, please contact Kent Reid (rkreid@nmhu.edu) or Ken Smith (kensmith@nmhu.edu) at the NMFWRI. It should be noted that this is a fluid document and that we will add new case studies on a periodic basis.

Project: **Sugarite Canyon State Park, Phase III**

Project size: 90 acres

Location: Colfax County, NM, northeast of Raton

Contact: Arnie Friedt, Cimarron District, NM State Forestry

Prescription:

The major justification for this project was to reduce the threat of crown fire, and thus protect the forest, part of the watershed of Lake Maloya and Raton, and the infrastructure in the state park. A secondary reason was to improve forest health and wildlife habitat. In addition, managers wanted to demonstrate that broad-sense restoration was compatible with fuels treatment.

- All slash was chipped on-site and blown out over the stand. Chip depth was 3" or less. Stumps were ground with the hydro-axe.

- All conifers that could serve as ground and ladder fuels were removed. Smaller-diameter conifers that were co-dominant or intermediate in the canopy were retained when appropriate to maintain an uneven-aged stand structure. The majority of trees with a DBH of 12 inches or greater that were in good health and of good form were kept.

- Clusters of larger oaks (>4 in. dbh) were retained. Small-diameter oaks were removed.

- Small wildlife habitat piles were allowed to remain in the watershed with the consultation of the N.M. State Game and Fish Department. These habitat piles measure 3' wide, 4' long and 2.5-3' high.

- Old (>50 years) piles of logs, which had been cut for mine timbers but never removed from the woods, existed in the stand. These were considered cultural artifacts, and were retained and not disturbed.

Treated stand in Sugarite Canyon State Park. Lake Maloya in the distance.

Implementation:

Hydro-axed with chipper attached, trees fed directly into chipper, chips on site. Work was carried out in the fall of 2006.

Measurements:

	before treatment	after treatment
Tree characteristics:		
Species composition: *ponderosa pine*	25%	93%
Douglas-fir	23%	1%
Gambel oak	52%	6%
Live trees per acre	767	148
Basal Area	125	50
Average diameter of mature trees	11 in.	16 in.
Canopy characteristics:		
Canopy closure	-	20%
Average crown base height	-	25 ft.
Costs per acre		$2,500

Observations:
This site was visited on Wednesday 4 April 2007, with Ernie Lopez (District Forester, Cimarron District, NM State Forestry) and Arnie Friedt (Timber Management Officer, Cimarron District). The forest floor and the residual trees exhibit almost no damage from the machinery that thinned the stand. Vigor of the residual trees has been increased, and threat from bark beetles is reduced.

Viewed from across the lake, the ground under the stand described above appears tan, as if it is bare soil. That tan is not soil, but is wood chips, and the color may change as the chips weather.

Ground fire could now be introduced into this stand without significant danger to the residual trees. The large amount of chips is a minor concern, however. A fire might get into the chips and smolder, producing a great deal of smoke and unexpectedly blazing up later. A fire that is too hot might burn all the chips, including any fine roots that have grown into the lower layers of the piles, which might harm the residual trees. A burn plan has not been prepared, although the park is open to the possibility.

Another site within the park was visited the same day. That area is east of Lake Maloya and adjacent to the Colorado state line, and was thinned under what park management calls "Phase I". The Colorado side was not really thinned, but the oak and locust was "mown" and now is growing back. The NM side has bigger trees, including snags, and was mechanically thinned. Some large chunks of wood are still on the ground. A consultant marked the first 2.5 acres of this stand as a broad-perspective restoration, and the thinning contractor cut the remainder of this stand, extrapolating from this initial mark.

Project: **Wildland-Urban Interface (WUI) in Piñon-Juniper, Ruidoso**

Location: Lincoln County, NM

Contact: District Forester, NM Division of Forestry, Capitan, NM

Prescription:

The purpose for this activity is to reduce wildfire intensity by removing excessive vegetation, thereby reducing the threat of catastrophic consequences from any fire that is ignited. Much of this work is in an area of transition between ponderosa pine and piñon-juniper (P-J), and characterized by a very open ponderosa pine overstory and a very dense P-J understory. This work is on private property, and almost exclusively in subdivisions and on lots less than 10 acres in size.

- All smaller trees are cut. Remaining trees are the largest, and are often "character" piñon trees.
- All slash is removed from the site or is piled and burned. Larger stems are removed or bucked into firewood and left for the landowner.
- Crowns of remaining trees are widely isolated from one another, a distance at least equal to crown diameter.
- Preference for leave trees is ponderosa pine > piñon > juniper.

Thinned piñon-juniper stand on private property northeast of Ruidoso. Note wide spacing between leave trees; initial stand was too thick to walk through. Also note Sierra Blanca range in distance.

Implementation:

Work usually is carried out by a contractor, although an individual landowner can do it themselves. Felling is with a chainsaw, and machinery may be used to move material out of the woods. Work began several years ago, and is on-going.
This work has been supported by grant money from NM State Forestry. Landowners apply for the program and prepare a plan, do the work, and are reimbursed on a cost-share basis, typically 70% of the total, when the work is complete and has been inspected. Costs vary by initial stand density, slope, and how much vegetation is cut and removed.

Measurements: all values are approximate

	before treatment	after treatment
Tree characteristics:		
Species composition: *ponderosa pine*	1 - 5%	10%
piñon	30-60%	80%
juniper	70-40%	10%
Live trees per acre	400-800	48
Basal Area	180-100	50
Average diameter of mature trees	2 in.	6 in.
Stand density index	-	-
Canopy characteristics:		
Canopy coverage	85-95%	20%
Average crown base height	0.5 ft.	4 ft.
Costs per acre		$900 - 1,800

Observations:
This area was visited on Wednesday 21 March 2007 with Bill Duemling, at that time Service Forester with the NM Division of Forestry in Capitan. Mr. Duemling had been performing a yeoman's task with landowners in the area for several years, and had barely scratched the surface of what needed to be done.

One of the challenges of working with landowners in this area is that most of them come from lower elevation areas that have no trees. They bought their property in the trees because they wanted a cabin that was visually isolated from their neighbors. A fuel-reduction thinning, to be effective, needs to remove most of the stems on a property. This is especially true in P-J, where a stand often is difficult to ignite, but burns completely if it does ignite, and takes buildings with it. A fuel-reduction thinning in P-J produces a stand that is very different from initial conditions, and aesthetically can be shocking. Due to the faith of the early adopters and the persistence of local field personnel, an open stand that is less susceptible to a crown-replacing fire is now more accepted.

Another challenge is the alligator juniper and its ability to grow back from cut stumps. So far, these low bushes are not big enough to be considered hazardous fuels, but individual landowners need to pay attention to them and continue to cut them back.

An additional minor observation here relates to the early thinnings, now several years old. A problem common to all managers and practitioners is a reluctance to cut enough trees from an overgrown stand the first time one of those stands is entered. The manager is uncertain the result will be accepted, and the upshot is that not enough trees are cut to make a difference in fire intensity or in overall forest health. These stands remain as rebukes to the practitioner, because they quickly reoccupy the site, yet entering them again so soon after the initial cut is too expensive. These stands are found wherever any fuels reduction program operates, and they are especially noticeable around Ruidoso, where the vegetation is thickest at eye level.

Project: **Hazardous Fuel Reduction and Forest Restoration, Silva Ranch**

Location: McGaffey, McKinley County, NM

Contact: Matthew and Mo Silva

Prescription:

This project was undertaken to reduce severity of wildfire and of insect outbreak. Heavily overstocked ponderosa pine stands, even-aged and generally uniform, were thinned to leave open stands that will allow rapid growth of the residual trees.

- Trees were thinned to a relatively even spacing; spacing depended on diameter.
- Cut trees were felled and left in place on the forest floor.
- Trees with better form or larger size were retained when possible.

Implementation:

Most work was done by the landowners and their family, using chainsaws. Work was carried out from the fall of 2004 through the fall of 2006.

Measurements: values are approximate

	before treatment	after treatment
Tree characteristics:		
Species composition: *ponderosa pine*	100%	100%
Live trees per acre	800	100
Basal Area	150	90
Average diameter	7 in	13 in
Canopy characteristics:		
Canopy cover	-	20%
Average crown base height	-	25 ft.
Costs per acre		$250 match

Observations:
This site was visited on Monday 23 April 2007, with Lawrence Crane (Bernalillo District, NM State Forestry) and Dr. Matthew Silva. The ranch has a stewardship management plan in place and on file with NM Sate Forestry. As a result, they are eligible to apply for and receive matching funds under the Forest Lands Enhancement Program, or FLEP. When fully funded, FLEP matches up to 65% of the costs associated with hiring a thinning contractor. The Silva family elected to do most of the work themselves, keeping track of their hours and expenses. Active thinning was carried out

for two years, and ended in the fall of 2006. The cost per acre listed above is the standard match for the work that was done.

As is to be expected on a ranch of more than 3700 acres, the ponderosa pine stands exhibit a variety of diameters, spacing, and quality, and any brief discussion such as this one must be limited to generalities. On the other hand, with one exception explained below, the three stands picked for treatment originated after a cycle of logging in the early 1900s, and had developed to the point they were heavily overstocked and stagnant. Stands contained a few larger trees that had been left, including some that appear to have been present as advanced reproduction during the logging. The great majority of the trees in the stands were 8 inches dbh and smaller. Quality of the stems, however, was above average. The area treated centers around the homesite, and totals 100 acres.

A stand was not marked before thinning. Larger trees and trees with better form were retained. The residual trees were evenly spaced, allowing new growth to be distributed on the best stems, which will result in the most valuable return at some future harvest date. Some standing trees that had been killed by bark beetles were cut, and most were removed and sent to a building supply company; smaller trees were piled and burned. With the exception described below, the felling was done by the Silva family using chainsaws. Slash treatment was lop-and-scatter except for 14 acres, were it was lop-and-pile.

With the exception of a few trees cut for firewood, and a trees sold as vigas and latillas to a building supply company, the vast majority of the cut trees still remain on the forest floor. Two problems are associated with this practice. First and most serious in the short-term is the danger of bark beetles. To avoid a bark beetle outbreak, current recommendations of the Southwest Region of the USDA-Forest Service are to remove immediately after felling all pine stems 4 inches in diameter and larger, when cutting between early spring and late fall. Sometimes, as happened here, the low background level of the beetles and the boost in vigor received by the residual stand is enough to avoid infestation, but these circumstances cannot be relied upon. The danger of bark beetle attack is short-lived, and had long past when this area was visited. The second problem is the increase in surface fuel. If a surface fire gets started in the treated areas before these felled trees are removed, it could burn hot enough to ignite the crowns, and nothing would have been gained by the thinning.

The lack of a small-diameter market is the principle reason these trees were felled and left in place. The Silvas attempted to identify markets and sell the material in an effort to offset the cost of thinning. They found that the proceeds did not cover the cost of retrieval and loading of the downed material, and they discontinued that effort. Processing the material in the woods might make such an effort economically feasible, but it would require an investment in harvesting and processing personnel and equipment that is beyond the means of most landowners.

Additional felled trees continue to be removed, without charge, by private parties as personal-use firewood. Since the visit, the Silvas have negotiated with a company in Milan that produces commercial heating pellets to remove the cut trees, and some trees have entered that supply stream. The Silvas are also burning some of the less-accessible

piles; on steeper slopes and in areas further from a road, most small-diameter material will always be too costly to remove, and the only practical treatment will be to burn it in place. The ranch also has been approved for additional matching funds under another program, and they have begun to treat another 62 acres; they are following ERI guidelines with that work, replacing pre-settlement evidence with residual trees (see below).

One area was an exception to the Silva family doing the work, and that was 100 acres adjacent to a section that is part of the Cibola National Forest. On that area, representatives from the Ecological Restoration Institute at NAU marked 2.5 acres as an example and for training, and local workers marked the remainder. This mark was what ERI calls a partial restoration, with 2 to 7 trees replacing evidence of pre-settlement trees (old stumps). The initial stand had a fair amount of dwarf mistletoe and porcupine damage, resulting in some spectacularly ugly trees. Many of these were open-grown and although large, had been established post-settlement and could be cut under ERI restoration guidelines. A commercial logger removed the cut trees. Slash was lopped and scattered, and the resulting surface fuel was discontinuous and presents no danger to the residual stand.

A portion of the forest thinned by the Silvas. The ridge in the distance was not visible before thinning began. Note the stems of cut trees lying on the forest floor.

Project: **Sacramento Ranger District, mixed conifer**

Location: Lincoln National Forest, Otero County, NM

Project size: 3.5 acres each combination

Contact: Red Baker, Doug Cram, and Glenn Mason, NMSU Cooperative Extension, Las Cruces

Initial stand:

Three areas – Bailey Canyon, Cox Canyon, and Sleepy Grass Campground – were selected for analysis. Treatment history varied for the areas, but all were classed as dry mixed conifer, dominated by Douglas-fir, with a Gambel oak understory. This study compared control plots and three thinning treatments: lop-and-pile, lop-and-scatter, and a commercial harvest. Data were collected by plots taken along permanent transects.

Among other hypotheses, the NMSU group tested the idea that crown fire potential is inversely related to treatment intensity. Measurements were taken on a wide variety of plants, and calculations based on those measurements were compared. Only limited, standard forest measures are presented here.

Treatment descriptions:

- Pile – a non-commercial lop-and-pile, thinned from below with chainsaws, with a 9-inch diameter cap and 16-foot spacing requirement.
- Scatter – a non-commercial lop-and-scatter, thinned from below with chainsaws, with a 9-inch diameter cap and 16-foot spacing requirement.
- Commercial – a non-commercial lop-and-pile followed by a commercial harvest a year later. Piles were burned or removed before the commercial harvest. The commercial harvest had a 24-in diameter cap and a target residual basal area of 80 ft^2/acre for the conifers when aspen clumps were present, and 100 ft^2/acre when they were not. Felling was done by chainsaw.
- Control – no thinning of woody material, but some of the areas were part of grazing allotments.

Implementation:

Treatments were carried out between 2002 and 2004. Data were collected in the summers of 2004 and 2005.

Measurements:

Treatment	Basal Area (ft^2/acre)	Density (trees/acre)	DBH (inches)	Litter wt (tons/acre)
	Stand Characteristics (averages)			
Bailey Canyon				
- control	173	246	14.3	2.15
- pile	107	106	14.8	2.62
- scatter	134	173	13.1	2.80
Cox Canyon				
- control	148	245	12.9	3.26
- pile	151	163	14.7	2.99
- scatter	130	160	13.1	2.94
Sleepy Grass CG				
- control	176	287	13.5	2.71
- pile	173	157	17.6	-
- commercial	104	77	19.7	2.28

The Scatter treatment in Cox Canyon. Note the leaning residual oak in the middle of the photo, and the untreated stand in the background. The potential fuel remaining on the ground was an important reason the Scatter treatment had little to no effect on potential crown fire initiation or active crown spread.

Observations:

The study area was visited on Tuesday 20 March 2007, with Glenn Mason and Doug Cram. Several study sites on the Sacramento Ranger District were visited. The sites used for Mason's work are described above, and his results will be discussed first. Mason's study is finished and was accepted for his Master's thesis at NMSU. Mason

performed statistical tests on the results, but the statistical jargon is omitted here; however, differences indentified in the discussion below are statistically significant.

Non-commercial treatments decreased overstory tree density but had little effect on basal area or canopy cover. Commercial treatment significantly altered overstory characteristics. Treatments tended to increase surface fuel, but the results were not consistent across sites, treatments, or through time. The Scatter and Commercial treatments significantly increased 1000-hr fuel loads, increasing the potential for stand damage. The same potential for increased stand damage existed in Pile treatment on a localized scale where piles were not burned.

Although they are not presented here, some calculations based on measurements and related to fire severity are worth mentioning. One of those measurements, crown bulk density, may not be reduced significantly until treatments approach the intensity of a commercial harvest unless the initial stand is less dense than usual for New Mexico mixed conifer. The Pile treatment had less potential for crown fire initiation (increased the torching index), but was still prone to crowning from oncoming fires (did not affect the crowning index) with the exception of the Bailey Canyon area. The Scatter treatment had little to no affect on potential crown fire initiation (decreased or did not affect the torching index) or active crown spread (did not affect the crown index). Commercial treatment drastically reduced the potential for crown fire initiation (increased the torching index) and active crown fire spread (increased the crowning index).

To sum up, the non-commercial treatments in this study failed to meet the management objective of substantially decreasing risk of crown fire. Results not presented here showed that commercial harvest may offer the most potential to increase shrub and herbaceous production. Commercial harvest also meets the goal of decreasing crown fire potential. The full results are in press, to be published as: Mason, J.G., T.T. Baker, D.S. Cram, J.C. Boren, A.G. Fernald, D.M. VanLeeuwen. 2007. Mechanical fuel treatment effects on fuel loads and indices of crown fire potential in a south central New Mexico dry mixed conifer forest. Forest Ecology and Management 251(3):195-204.

The study described above looked at current silvicultural prescriptions. In addition, NMSU researchers are designing and studying new silvicultural prescriptions, and those study sites also were visited that day in March. Current work in the mixed conifer cover type tests operational implementation of an uneven-aged group selection prescription designed by Doug Cram. The marking strategy was to retain desired and acceptable growing stock trees to meet stocking targets in multiple diameter classes. The most desirable groups and/or trees in each diameter class were retained. Retained trees generally had the best phenotypes, vigorous-looking crowns, and little forking or other evidence of past damage; however, some marginal-quality trees had to be retained due to original stand composition and structure. Trees infected with dwarf mistletoe were marked for removal. In addition to multiple diameter classes, ¼ to ½ ac openings were created. These "gaps" were designed to help reduce crown fire danger as well as restore natural openings within the forest. Large diameter trees were retained in and around these gaps to serve as a seed source and to provide some shelter for the opening. Desired future conditions for understory vegetation, fuels, and wildlife follow from these overstory conditions.

In a different, region-wide study, members of this same research group looked at recent silvicultural treatments in ponderosa pine to see if treatment would make the stands less susceptible to stand-replacing wildfires. They examined stands of known harvest history after wildfire had passed through those stands, and found that the more aggressive the treatment, the more protected the stands were from crownfire. Significantly, lop-and-scatter treatment of slash left stands susceptible to severe fire damage. This Research Paper was published in 2006 by the Rocky Mountain Research Station as RMRS-RP-55, *Wildland fire effects in silviculturally treated vs. untreated stands of New Mexico and Arizona*. It is available on the NMFWRI website or the RMRS website at www.fs.fed.us/rm/publications/titles/rmrs_research_papers.html

Project: Tijeras Ranger Station WUI **Project size:** 1500 acres

Location: Tijeras, Bernalillo County, NM

Contact: Alan Kelso, Sandia District Office, Cibola National Forest

Prescription:

Reduction of the unnaturally heavy fuel loads in the piñon-juniper (PJ) stands on Cibola National Forest land surrounding Tijeras was the impetus for this project. In addition, management of off-highway-vehicle impacts was a consideration. The District feared that opening up the stands to the point that they were no longer susceptible to uncontrollable wildfire would also open them up to excess OHV use, which is extremely heavy in the immediate area. District engine crews, some of whom use OHVs recreationally, developed the following prescription to meet the dual goals of fuel reduction and protection of thin soils from excessive OHV use. Recovery of herbaceous vegetation was also a goal, to reduce soil loss. Protection of a crushed rock, ditched road from vehicles going off road and returning with clay mud on wheels was a goal.

Throughout the interior of the treated area:

- Thin heavily to remove about 70% of the original stems, resulting in good crown separation.
- Favor piñon as leave trees; however, the untreated stand is almost 90% juniper, so some juniper will be left. Leave the largest trees. Prune off limbs under 5 inches diameter which can be safely reached.
- For fine limbs: lop them, hand pile into small piles, and burn after curing.
- Leave main stems on-site. Move them only once, to leave them oriented along the contour for catching eroding soil.

Inside a 70-foot buffer along the roads:

- Remove fewer trees, resulting in a significantly denser stand than in the interior of the area, with less crown separation and occasional clumps.
- Leave some branches on trees that in the prescription above would be pruned.
- Scatter cut trees, but other than major full-length branches, do not lop them.
- Leave higher-than-normal (i.e., 12 inch) stumps.
- Leave the trimmed and topped tree trunks lying on the ground, on the contour, for catching eroding soil. Issue no wood permits for the area.

Implementation:

The District's work and fire crews developed and carried out the prescription starting in the fall of 2006. Cutting was done with chain saws.

Measurements:

		before treatment	after treatment
Tree characteristics:			
Species composition:	*Piñon*	10%	30%
	One-seed juniper	90%	70%
Live trees per acre		540	56
Basal Area		-	-
Average root collar diameter		6 in.	12 in.

Costs per acre: $400 - 800

Observations:

This site was visited on Monday 26 November 2007, with Alan Kelso, silviculturist for the Cibola National Forest. Limited soil buildup was observed above the on-the-contour stems, probably because very little overland soil movement had occurred. Herbaceous response is remarkable, and will serve as a deterrent to erosion. Grazing is never scheduled for this area.

The small piles had been burned. From ash and the recovering vegetation, these piles had covered 10 square feet or less (about 3 feet in diameter). Kelso reported that they had burned very quickly, with very little smoke, within air quality standards for the Albuquerque area.

By the time of this visit, the scattered-but-not-lopped stems and branches in the buffer area had begun to settle into the ground, and were less of a deterrent to OHV use than they had been when newly cut. The high stumps remained, however, and the site exhibited no evidence of either OHV use or vehicle use related to firewood gathering.

Thinned piñon-juniper near Tijeras, with the Sandia Crest in the background. Note the wide spacing between trees, the branch stubs left from pruning, and the branches left on the ground.