BAER Monitoring Report Year One
Silver Fire
Gila National Forest, Region 3
May 2014

*photo taken September 6, 2013, East side of Black Range along Highway 152 looking up Drummond Canyon

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Silver Fire Burned Area Emergency Response 2013 Level II Monitoring Report

Introduction

In June and July 2013, the 137,326 acre Silver Fire burned large, contiguous tracts of National Forest System Lands in the southeastern portion of the Gila National Forest. The majority of the high severity burn (20,793 acres) and moderate severity burn (36,931 acres) was limited to mixed conifer vegetation type with a much smaller percentage occurring in the pine vegetation type of the extremely steep and rugged Black Range. The fire left several communities, many private properties and County, State and Forest Service infrastructure at risk from post-fire flooding, sedimentation and debris flows. The BAER team conducted an assessment of the fire and made recommendations to minimize negative post-fire effects. Recommendations included aerial application of certified weed free straw to 2,880 acres of high severity burn and aerial application of certified weed free seed to 12,900 acres of high severity burn. A three year post fire treatment effectiveness monitoring plan was developed. This report outlines the objectives, data collection/analysis methodologies and first year monitoring results.

Monitoring Objectives

The following are the objectives this monitoring plan is intended to address.

1. Evaluate effectiveness of seeding and mulching/seeding in increasing canopy and vegetative ground cover using an annual barley and native seed mix verses no treatment
2. Evaluate the effect that post fire seeding or mulching and seeding has on maintenance of site/soil productivity
3. Evaluate if these treatments were effective on steep slopes of between 40 to 65 percent
4. Evaluate the effects of these treatments on regeneration of fire adapted species
5. Determine if these treatments introduced invasive species
6. Evaluate the effects of treatments on natural recovery and site diversity

The design of this monitoring plan incorporated a multiple year approach. Due to this design, not all of the above objectives will be addressed until monitoring has been concluded.

Selection of Monitoring Sites

This study stratified monitoring plots based upon high burn severity, vegetation types of mixed conifer and ponderosa pine and the 3 treatment types of *mulched/seeded*, *seeded* and *non-treated*. Locations for establishment of monitoring sites were identified in the office with the aid of the burn severity map, BAER treatment map, the Forests Terrestrial Ecological Unit Inventory and Midscale Existing Vegetation maps prior to site visits and plot establishment. Due to the remoteness, steep topography and lack of trail access, some treatment units could not logistically be sampled and were not considered. The design was intended to distribute monitoring plots throughout the treated and non-treated areas of the Silver Fire while attaining a fair representation of the treatment units in the burned area (*see appendix A for map of monitoring plot locations*). Elevation of monitoring sites ranged from 7,200 feet to 9,600 feet. A total of eighteen permanent plots were identified to be set up throughout the burn area. Only seventeen were established prior to the area receiving significant snow cover that prevented establishment of one of the plots. There were a total of twenty seeding units in the burned area, varying in size from 72 to 2,203 acres. Six of these treatment units had plots established in them resulting in 30% of the seeded treatment units being sampled. There were a total of eight mulch/seeded units in the burned area varying in size

from 64 to 1,246 acres. Five of these treatment units had plots established in them resulting in 63% of the mulch/seeded treatment units being sampled.

Data Collection Method

Data was collected using two monitoring protocols developed by the USDA – ARS Jornada Experimental Range, Las Cruces, New Mexico and can be found and described in the publication *Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems, Volume I and II.* http://www.ntc.blm.gov/krc/uploads/281/Monitoring%20Manual%20for%20Grassland,%20Shrubland%20and%20Savanna%20Ecosystems%20Vol.%20.II.pdf The protocol used to collect canopy cover and ground cover data was the Line-point intercept. Line-point intercept is a rapid, accurate method for quantifying the components of soil cover which include vegetation, litter, rock, biotic soil crusts and bare soil. These measured attributes are related to erosion, infiltration and the ability of the site to resist or recover from degradation. Line-point intercept is used for generating ground cover data which is essential for erosion prediction modeling and is also useful in determining plant cover and composition. At each monitoring plot three permanent 100 foot transects were established parallel with the contour of the slope. At the start of every transect photo points were established down the transect line, upslope, downslope and in the opposite direction of the transect line. Additionally vegetation canopy cover was also collected on a tenth acre circular ocular plot at each monitoring site. This was done to pick up or account for plant species and their associated cover values that were present on the site but not picked up on the Line-intercept transects. *See appendix B for plant list of species encountered at monitoring plots.* The other protocol used was a Gap intercept method which was used to measure the amount of regenerating shrub or tree canopy cover encountered along a transect. Data was collected during the months of October and December 2013 by Mike Natharius and assisted by either, Jenny Natharius, Nori Koehler or Micah Kiesow.

2013 Results

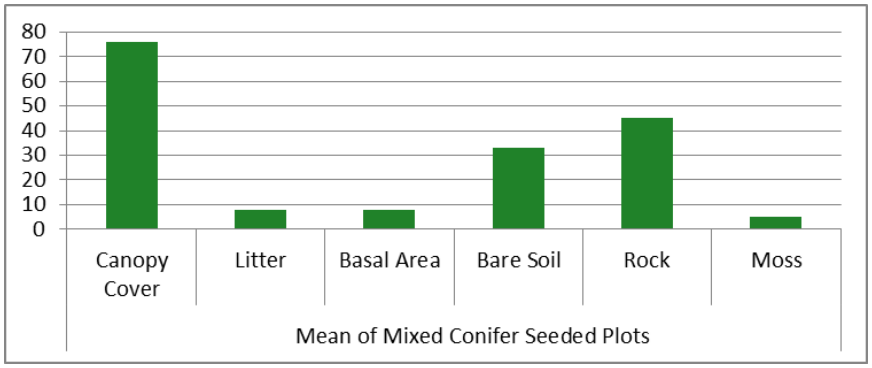
Monitoring Objective 1.

Evaluate effectiveness of seeding and mulching/seeding in increasing canopy cover and vegetative ground cover using an annual barley and native seed mix vesus no treatment

Aerial seeding occurred on 12,900 acres of high severity burn throughout the Silver Fire. Seed was applied at approximately 53 pounds per acre or 23 seeds per square foot of the seed mix. The seed mix consisted of annual barley (15 seeds/ft^2) and a smaller percentage of native grass species (8 seeds/ft^2) common to the area. On the ground inspections of seeding application rates were monitored during aerial application, and application rates were fairly accurate at the sites monitored. Aerial seeding of the fire was completed by July 26th. The burned area received precipitation prior to the completion of the seeding effort. Precipitation data from the McKnight SNOTEL site which is located in the Silver Fire burned area shows that between July 21st and October 30th the area received 14.7 inches of precipitation (http://www.wcc.nrcs.usda.gov/nwcc/site?sitenum=1048&state=nm). These dates correspond with the start of the seeding effort and the end of the growing season of the burned area. A total of seventeen monitoring sites were established throughout the burned area. These were tiered on pre-fire vegetation types of pine and mixed conifer and treatment types of mulched and seeded, seeded only, and non-treated. Three plots were established in each vegetation and treatment type. The following graphs display the mean canopy and ground cover percent's from the first years monitoring of the seventeen permanent plots. *See appendix C for individual plot data and photo of individual monitoring sites.*

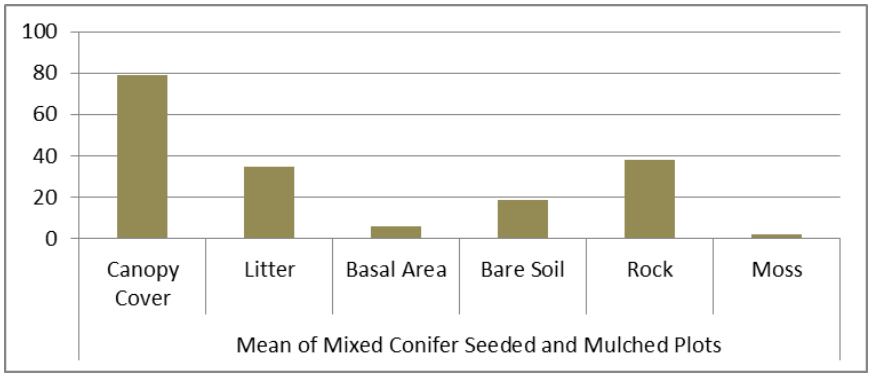
Mean of Mixed Conifer Seeded Plots

Canopy Cover	Litter	Basal Area	Bare Soil	Rock	Moss
76	8	8	33	45	5



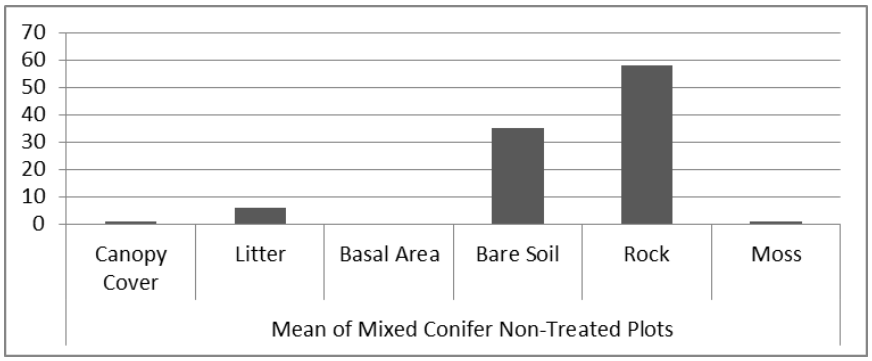
Mean of Mixed Conifer Seeded and Mulched Plots

Canopy Cover	Litter	Basal Area	Bare Soil	Rock	Moss
79	35	6	19	38	2



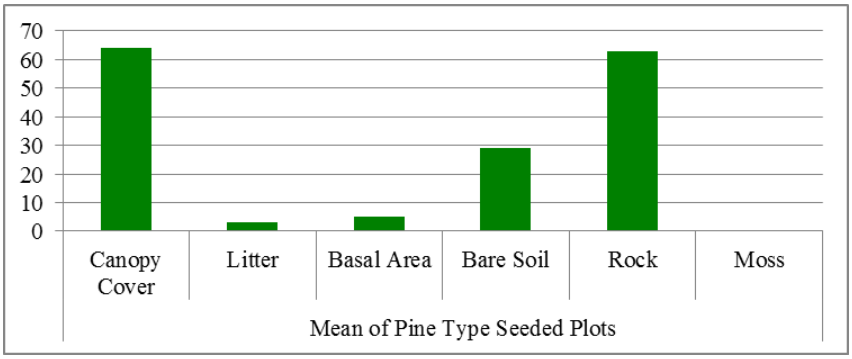
Mean of Mixed Conifer Non-Treated Plots

Canopy Cover	Litter	Basal Area	Bare Soil	Rock	Moss
1	6	0	35	58	1



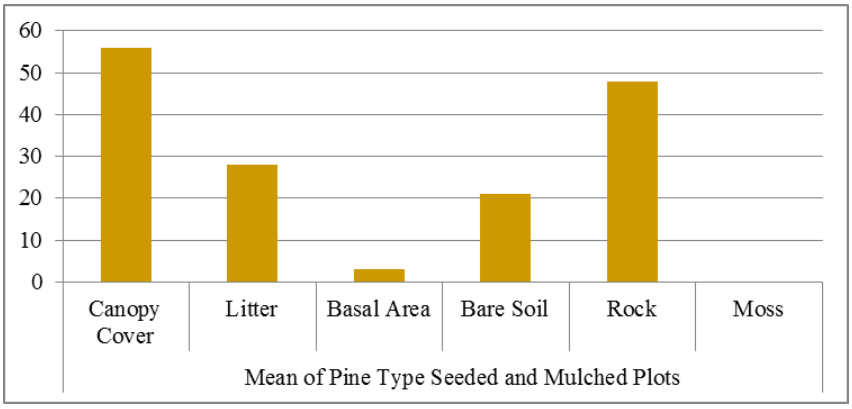
Mean Percentages of Pine Type Seeded Plots

Canopy Cover	Litter	Basal Area	Bare Soil	Rock	Moss
64	3	5	29	63	0



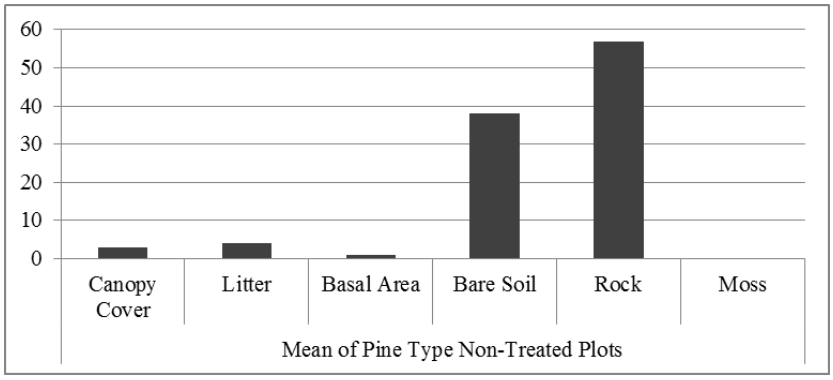
Mean Percentages of Pine Type Seeded and Mulched Plots

Canopy Cover	Litter	Basal Area	Bare Soil	Rock	Moss
56	28	3	21	48	0

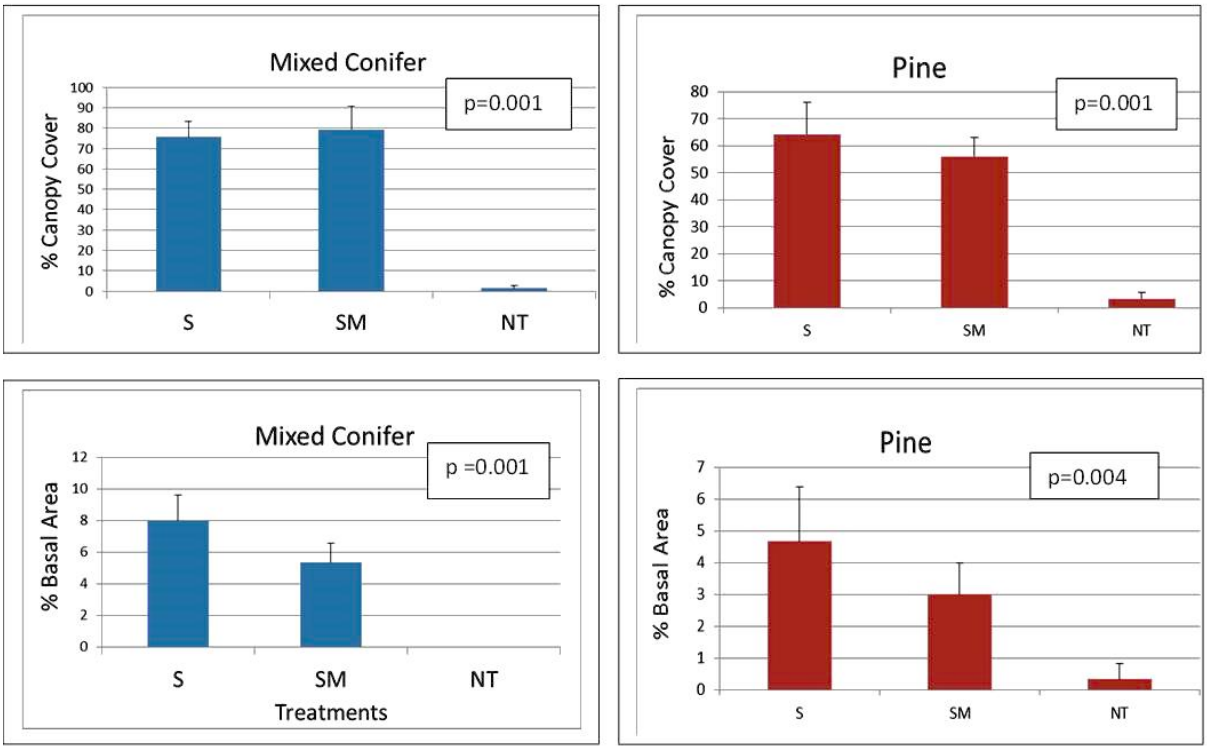


Mean Percentages of Pine Type Non-Treated Plots

Canopy Cover	Litter	Basal Area	Bare Soil	Rock	Moss
3	4	1	38	57	0



Significance tests were performed on the mean canopy, basal area and litter cover values of the three treatment types of seeded (S), seeded/mulched (S/M) and non-treated (NT) at the 5% significance level. There was not a significant difference between canopy cover and basal area values in the seeded and mulched/seeded plots in either of the two vegetation types. However, there was a significant difference in canopy cover and basal area between the treated and non-treated plots in the two vegetation types. The following graphs display the differences and the standard deviation within a treatment type.

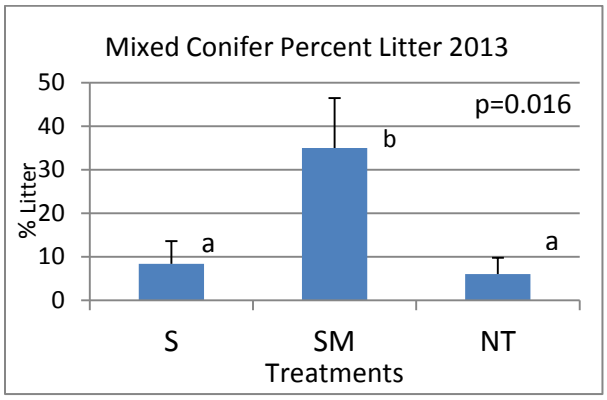


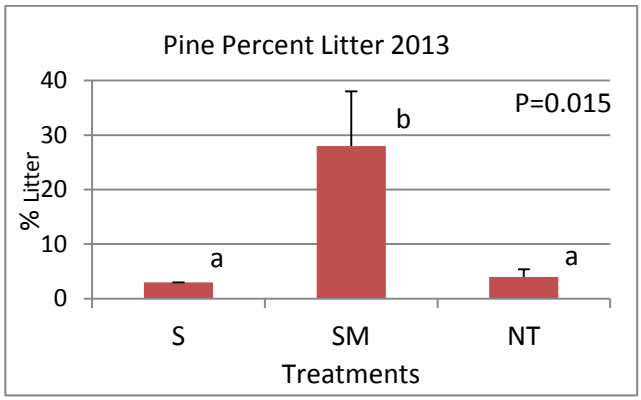
Mean canopy covers were very similar in the seeded and seeded/mulched mixed conifer sites, with canopy covers of 76% and 79% respectively. Differences were larger in the seeded and seeded/mulched pine type with mean canopy covers of 64% and 56% respectively. This might be attributed to differences in site characteristics between the treatment types or only having data from two mulched/seeded pine type plots instead of three. Mean basal area of both vegetation types were higher with the seed only treatment. It was noted during the monitoring that the annual barley tended to have a slightly different growth form with more basal leaves and less plant height in the seeded sites and that the annual barley was more single stemmed with less basal leaves and taller in the seeded/mulched areas.

Seeded only – higher amount of basal leaves and less height

Seeded/mulched – single stemmed and taller

The following graphs display the mean percentages of litter in the three treatment types and standard deviation.





These graphs illustrate that mulching did increase litter and as would be expected there was very little litter found in the seeded and non-treated plots and the litter present was comprised of unconsumed branches, roots and logs. It should be noted that litter was defined as being 0.5 inches thick. This depth was considered capable of being effective in reducing raindrop impact and soil detachment, assisting in infiltration and slowing overland flow on steep slopes that experience high intensity rainfall events. Straw application rates of 1 ton/acre, which is equivalent to a 1 inch depth per acre, were adhered to during aerial mulching operations. Prior to application of the straw it was fluffed to reduce clumpiness and provide for more uniform coverage. This resulted in fairly uniform coverage, though the 1 inch application rate was not met in all cases. Monitoring plots were established and read in the fall after the monsoon season which had caused the straw to flatten and settle, to depths in many cases less than 0.5 inches. Field observations noted that erosion was reduced on those sites that were mulched over those sites that were not mulched. Rock and bare soil data were not analyzed as this first years' monitoring data served to establish a baseline. Analysis of this data will be done in years 2 and 3.

Generally the pine sites occurred on warmer, drier southerly facing slopes or at lower elevations of the burned area and the mixed conifer occurred at higher elevations or on the cooler, moister northerly facing slopes. It was noted throughout the monitoring and the data displays this, that generally the pine sites did not produce as much canopy cover, plant height and basal area as the mixed conifer sites. Production

estimates of the annual barley were done throughout the monitoring and it was estimated that mixed conifer sites produced between 1,500 to 3,000 pounds/acre and that pine sites produced from 750 to 2,000 pounds/acre. The seeding treatment had not increased litter at the end of the growing season when the monitoring plots were established and read in October thru December of 2013. It is expected that the annual barley will provide for very effective ground cover in 2014, assisting in reducing erosion and maintenance of soil/site productivity. Both seeding and mulched/seeded treatments were deemed to be highly effective in providing canopy and ground cover in 2013. Canopy cover provided by the annual barley had become well established one month after seeding, and was effective in providing for erosion control during the remainder of the 2013 monsoon season. *See appendix D for August and September photo points displaying annual barley growth.*

Monitoring Objective 2.

Evaluate the effect that post fire seeding or mulching and seeding has on maintenance of site/soil productivity

A lot of thought was put into how to address this monitoring objective. Site or soil productivity is associated with the top soil horizons (topsoil) where the highest concentration of organic matter, microbial activity and nutrients are located. When erosional processes remove these surface layers soil productivity is diminished. Soil formation is an extremely slow process which may take hundreds of years to form 1 inch of soil. After much consideration it was determined that comparing relative differences in modeled erosion would assist in addressing this objective. All erosion models require similar inputs of soil texture, slope percent's, slope lengths, number of slope segments, cover values and precipitation data or runoff volumes. The Hillslope Erosion Model was used to model erosion for the Silver Fire using cover values collected at the monitoring sites. Runoff volume was determined using a 5 year 24 hour rainfall event in conjunction with curve numbers that were generated for the two vegetation types of Pine and Mixed conifer. Input values of soil texture, slope and slope length were held constant for all model runs. ***It should be made clear that the intent of the erosion modeling was not to come up with absolute erosion rates but rather to display relative differences in modeled erosion rates from the 3 treatment types of mulched/seeded, seeded and no treatment.***

Incorporating the cover data collected at each of the treatment plots into the HEM model, relative differences in erosion rates were calculated between treatment types. Mixed conifer sites show yields of 54% less erosion in the seeded/mulched areas when compared to the no treatment areas. Seeded areas in the mixed conifer sites show yields of 36% less erosion when compared to the no treatment areas. In the pine type the seeded/mulched areas yielded 74% less erosion compared to the no treatment areas. Seeded areas in the pine type yielded 52% less erosion compared to the no treatment areas.

As would be expected modeled erosion rates were significantly less in the treated verses the non-treated areas of the fire and mulched/seeded sites produced less erosion than seeded only sites. The results show that increases in canopy and ground cover from either mulching/seeding or seeding yield less sediment than areas of no treatment. Results from this modeling exercise indicate that treatments were more effective in maintaining soil/site productivity than no treatment. Plot cover data will be collected and evaluated for the next 2 years.

Monitoring Objective 3.

Evaluate if treatments were effective on steep slopes of between 40 to 65 percent

The Silver Fire occurred in the steep mountains of the Black Range, over 80 percent of the burned area occurred on slopes of greater than 40 percent. The following table shows slope classes and acres of treatments by treatment type and number of monitoring plots by slope class by treatment type.

Slope Classes	Seeded Acres and *Number of Plots	Percent of Total Acres	Seeded/Mulched Acres and *Number of plots	Percent of Total Acres
0 to15%	412 Acres *(0)	4%	62 Acres *(0)	2%
15 to 40%	3,389 Acres *(0)	34%	617 Acres *(1)	22%
41 to 50%	2,311 Acres *(3)	23%	583 Acres *(2)	21%
51 to 65 %	3,970 Acres *(3)	39%	1,577 Acres *(2)	56%

From evaluating the plot data and from personal field observations it appears that both the seeding and the seeding/mulching were effective on steep slopes of 40% to 65%. There were no plots established on slopes greater than 65%, although there were some treatments applied to slope slightly greater than 65%. There was variability noted between treatments on similar slopes and aspects and variability also occurred within the individual transects at the plots. Site factors such as geology type, soil type, depth of soil and inherent soil productivity appeared to have a much greater influence on treatment effectiveness and success than slope did.

Monitoring Objective 4.

Evaluate the effects of treatments on regeneration of fire adapted species.

In conjunction with the line point intercept data collected at the monitoring sites a Gap intercept method was also done on transects in the plots to measure the amount of regenerating shrub and tree canopy encountered along the transects. It should be noted that all sites are not created equal and that some sites have a higher potential than others for regeneration of fire adapted species. Pre-fire stand composition and species frequency determine post-fire figures. The intent of this vegetation monitoring method was to capture change in canopy over time. In addition to the Gap intercept method a tenth acre ocular plot was done at the start of transect #2 at each plot. This was intended to capture species and associated canopy covers that may not have showed up in the Line Point intercept and the Gap intercept transects.

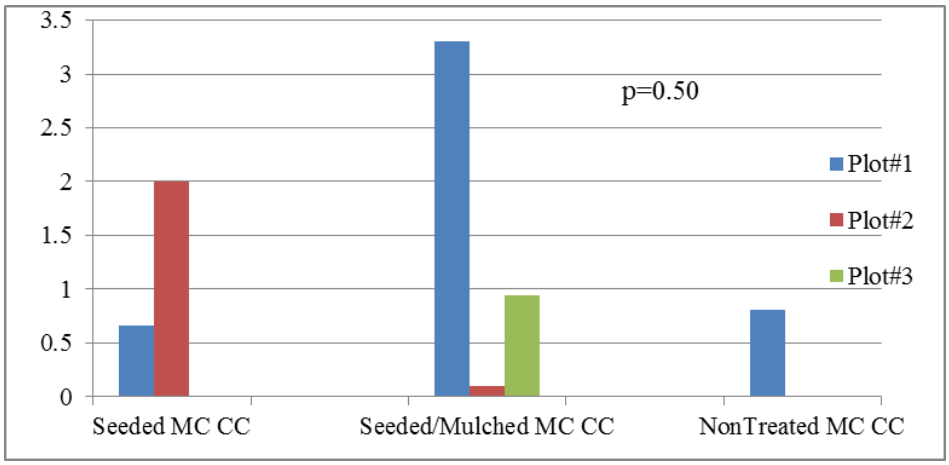
Fourteen of the seventeen monitoring plots showed regeneration of oak species, locust, maple or raspberry. The data indicates that regeneration of fire adapted species was not inhibited or suppressed in the treatment units, thus far. They showed similar vigor and averaged the same height and leaf size as the non-treated areas. The graphs on the following page display canopy covers of fire adapted species by plot and vegetation type. There is no significant difference between treated and non-treated areas.

Gambel oak regeneration on a seeded/mulched area

Gambel oak regeneration on a non-treated area

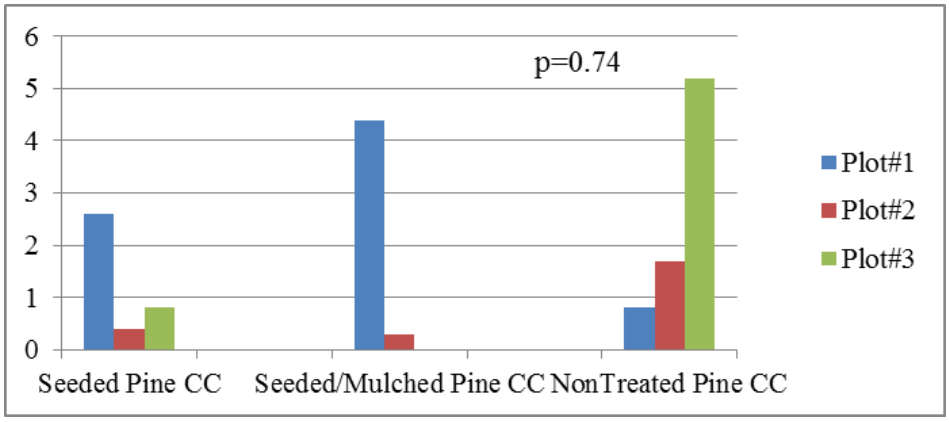
Summary of Mixed Conifer Fire-Adapted Species Canopy Covers

	Seeded MC CC%		Seeded/Mulched MC CC%		Non -Treated MC CC%
Plot#1	0.66	Plot#1	3.3	Plot#1	0.81
Plot#2	2	Plot#2	0.1	Plot#2	0
Plot#3	0	Plot#3	0.94	Plot#3	0



Summary of Pine Type Fire-Adapted Species Canopy Covers

	Seeded Pine CC%		Seeded/Mulched Pine CC%		Non-Treated Pine CC%
Plot#1	2.6	Plot#1	4.4	Plot#1	0.81
Plot#2	0.4	Plot#2	0.3	Plot#2	1.7
Plot#3	0.8	No Plot#3	XXX	Plot#3	5.2



Monitoring Objective 5.

Determine if these treatments introduced invasive species

Wheat straw was used for mulching and was certified weed free of plants listed on the State of New Mexico's noxious weed list. Seed was also certified weed free. In the course of completing the treatment monitoring over 25 miles of trails were either ridden or hiked numerous times within the Silver Fire and inventoried for invasive or noxious weeds. This occurred during the months of October, November and

December 2013. While not all treatment polygons were sampled with monitoring plots a majority were visually inspected. No invasive or noxious weeds were detected. Inventories will continue on into 2014 and 2015.

Monitoring Objective 6.

Evaluate the effects treatments have on natural recovery, diversity and overall site recovery

This monitoring element will be addressed as monitoring continues.