San Cristobal PJ Project 16-10

Pretreatment Monitoring Report

2016

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for
the Greater Rio Grande Watershed Alliance

Santa Fe-Pojoaque SWCD

Contents

Acronyms and Abbreviations

Acronym, Abbreviation, or Term	Explanation or Definition as used by NMFWRI
AVE and AVG	Average
BA/AC	Basal area per acre
BEMP	Bosque Ecosystem Monitoring Program
Chain	66 feet
DBH	Diameter at breast height (4.5 feet)
DIA	Diameter
DRC	Diameter at root collar (used for woodland species e.g. *Juniperus*)
DWD	Down woody debris
FEAT	Fire Ecology Assessment Tool
FFI	FEAT/ FIREMON Integrated
FIREMON	Fire Effects Monitoring and Inventory System
GIS	Geographic Information Systems
GRGWA	Greater Rio Grande Watershed Alliance
HD	Herbaceous dead (dead non-woody species)
HL	Herbaceous live (live non-woody species; herbs)
HT	Height
LiCrBHt	Live Crown Base Height, distance from ground to start of live crown
LIDAR	Light detecting and ranging, a remote sensing technique using light to gather elevation data
NAIP	National Agriculture Imagery Program (aerial imagery)
NMED	New Mexico Environment Department
NMFWRI	New Mexico Forest and Watershed Restoration Institute
NMHU	New Mexico Highlands University
NMRAM	New Mexico Rapid Assessment Method, version 2.0
NRCS	Natural Resource Conservation Service
PC	Plot center
PLANTS symbol	Abbreviation of scientific name used in Plant List of Accepted Nomenclature, Taxonomy & Symbols (USDA database)
PJ	Piñon-juniper vegetation community
QMD	Quadratic mean diameter, always equal to or greater than mean DBH, always an average
RGIS	Resource Geographic Information System
Sapling	Height is over 4.5 feet but DBH is under 1”
SD	Standing dead (dead woody species)
Seedling	Height is under 4.5 feet
SFPSWCD	Santa Fe-Pojoaque Soil and Water Conservation District
SL	Standing live (live woody species)
SWCA	National environmental consulting firm with an office in Albuquerque
SWCD	Soil and Water Conservation District
TPA	Trees per acre (Trees/acre)
“Tree”	Height is over 4.5 feet, with DBH over 1”; includes “live” and “sick” individuals
USDA	United States Department of Agriculture
WSS	Web Soil Survey, a soils database of the NRCS

Purpose of Report

This report covers pretreatment vegetation monitoring assessment performed on a watershed health improvement/thinning project submitted for an area of San Cristobal Ranch piñon-juniper woodland/savanna to the Greater Rio Grande Watershed Alliance. Following an explanation of monitoring methods, we will discuss background, observations, and assessment results for the project.

An Introduction to Piñon-Juniper in New Mexico

A general overview of piñon-juniper woodland communities and conditions is drawn from *New Mexico Vegetation: Past, Present, and Future* by William Dick-Peddie (1993). This overview is general by necessity: in New Mexico, piñon-juniper (PJ) woodlands are widespread, covering nearly 27% of the state[1] (see Figure 1, below). They have a variety of soil types and plant community associations. In addition, they have received less study attention than other vegetation types such as coniferous forests and grasslands because they have less timber and grazing value.[2] As such, there is not presently an authoritative source for reference conditions. There are a number of piñon-juniper identification systems and keys, including those proposed by Moir and Carleton (1987), Dick-Peddie (1993) (which we mention here primarily for their succinct summary of the state), the NRCS (1997), Romme et al (2007), Jacobs et al (2008), the New Mexico Forest Restoration Principles Working Group (2007) and the New Mexico State Forestry Working Group (2007) (see Appendix II), and many others. NMFWRI has been involved with the latter two groups and can provide information on their proposed keys and frameworks upon request.

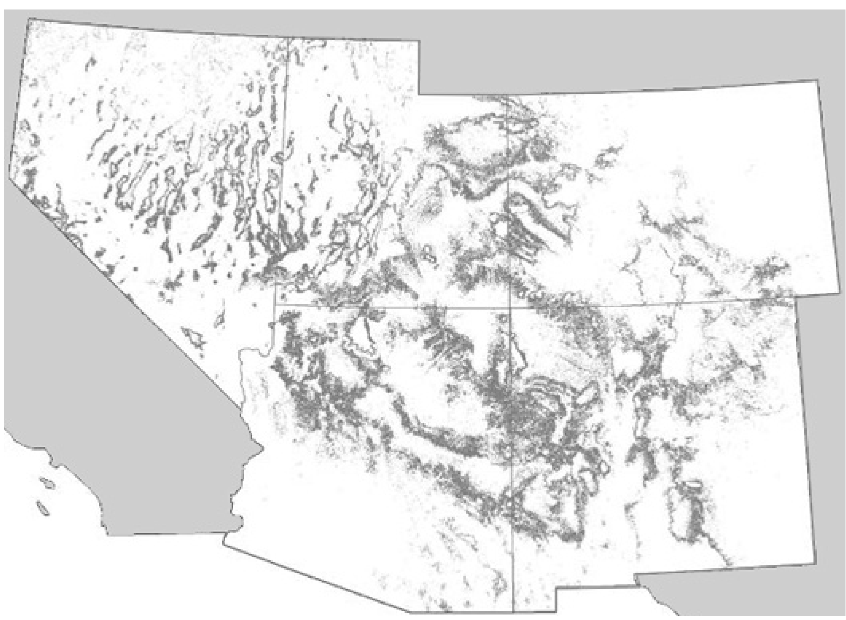


Figure 1. Piñon-Juniper distribution in NV, UT, CO, AZ and NM.[3]

[1] (Pieper, Rex D, 2008) p 3
[2] (Dick-Peddie, 1993) p 86
[3] (National Park Service, 2015)

According to Dick-Peddie (1993), "Moir and Carleton (1987) propose the following three elevational subzones for the woodland life zone of Region 3 (Arizona and New Mexico).

1. The aridic (warm, dry) juniper savannas
    a. Tree cover: 5-30%
    b. Height of tallest trees: <5m
2. Typical or model open woodland
    a. Tree cover: 30-50%
    b. Height of tallest trees: 4-8m
3. Mesic (cool, wet) closed woodlands
    a. Tree cover: 50-80%
    b. Height of tallest trees: 7-13m"[4]

As for common vegetation components, "Colorado Pinyon (*Pinus edulis*) is by far the most common pinyon of the Pinyon-Juniper woodland vegetation of New Mexico…One-seed Juniper (*Juniperus monosperma)* is the most widespread juniper in New Mexico. It may share dominance with Rocky Mountain Juniper in the northern third of the state."[5]

An example of the variation in forest structure within PJ woodlands may be illustrated by this example: "Kennedy (1983) found an average tree density of 170/ac in the *Pinus edulis – Juniperus monosperma/S* [sparse shrub layer]*/Stipa Columbiana* communities of the Jicarilla and Sacramento mountains in south-central New Mexico. The Forest Service in New Mexico indicates that in closed *Pinus edulis – Juniperus/Artemisia tridentata/*MG-F [mixed grass and forb species] communities of north-central and northwestern New Mexico, tree densities may be 690 plus or minus 120 individuals per hectare (279 trees/ac plus or minus 49)."[6]

It is widely accepted that PJ Woodlands have changed over time, for various reasons. These include PJ "encroachment" into grassland savannas under the influence of climate change, drought, and altered fire regimes related to heavy grazing that has removed fine fuels capable of carrying surface fire. Gottfried (1995) further asserted that many PJ systems "are unstable from a soil perspective, with many moving towards PJ rocklands,"[7] as a result of these environmental stressors. Another force at work is the return of woodland to sites that were previously woodland (re-occupation)[8]. For example, Dick-Peddie (1993) asserts that "it is not uncommon to find seral Pinyon – Juniper Woodland vegetation as a result of past disturbance of coniferous forest. In New Mexico, the disturbed forest has usually been ponderosa pine forest. The presence of young ponderosa pines in pinyon-juniper woodland could signify the successional nature of the stand."[9] In addition, he notes that many lower elevation PJ Woodlands were formerly Ponderosa Pine/Blue Grama habitats, which suggests that under warming climates, PJ may be the present/future vegetation potential for other ponderosa pine forests.[10] Dick-Peddie (1993) states that much discussion of PJ involves encroachment or expansion onto grassland, but acknowledges

[4] (Dick-Peddie, 1993) p 88
[5] (Dick-Peddie, 1993) p 89
[6] (Dick-Peddie, 1993) p 87
[7] (Pieper, Rex D, 2008) p 7
[8] (Pieper, Rex D, 2008) p 7
[9] (Dick-Peddie, 1993) p 87
[10] (Dick-Peddie, 1993) p 68

that Sallach (1986) suggests that "much of the recent increase of pinyon-juniper woodland on grassland in the mountains of New Mexico is actually a return of woodland to sites that had previously been woodland."[11] NMFWRI takes the position that the PJ woodland expansion into grassland of the past 80 years is due to a combination of grazing practices and fire exclusion.

The respective contributions of climate change and management in shifting species composition is relevant because 2016 GRGWA RFP (p 42) states that the purpose of this treatment at San Cristobal is to "create a large, open patchy grassland" while reducing erosion, improving natural hydrologic function, increasing forage for grazing and wildlife, and improve ecosystem health. The implications of Dick-Peddie's (and others') observations are that over time, with climate change, the site may not successfully maintain higher proportions of grassland created through treatments. Undoubtedly human maintenance efforts, such as prescribed fire, will be important.

Monitoring and Field Methods

While in previous years, the majority of the Greater Rio Grande Watershed Alliance's (GRGWA) restoration projects have been focused on the bosque, recent years have seen the expansion of focus into other "watershed health" treatments such as this PJ thin. Since 2013, the New Mexico Forest and Watershed Restoration Institute (NMFWRI) has been working with GRGWA and the Claunch-Pinto Soil and Water Conservation District (SWCD) to begin construction of a geodatabase for all of GRGWA's non-native phreatophyte removal and restoration projects, as well as to perform the formal pre- and post-treatment monitoring. NMFWRI uses a standard set of protocols originally proposed by SWCA for bosque monitoring, including NMED's NMRAM and BEMP-style plots; the Department of Interior's FEAT/FIREMON Integrated sampling protocols are used for upland monitoring. NAIP or LIDAR analysis is also used where appropriate and available; these assessment tools were not utilized in analysis of this project.

Plot Distribution

We have 14 plots distributed over across approximately 170 acres which are split into two polygons (the northern polygon is 70 acres, and the southern is 103 acres). Each plot's location was established within the study area provided by Fred Rossbach on behalf of GRGWA. A stratified random sampling design was employed to assign the monitoring plot locations. These plot locations were stratified in that they needed to fall inside the study area boundary, be a set number of points, and be located no closer than 100 meters (328 feet) apart.

Under a traditional forest cruise done to determine volume and value, the number of plots would be sufficient to sample an area not less than 1/10th of the total area. For example, if the study area were 640 acres we would ideally assign 64 1/10th acre plots. The large amount of acreage within these study area polygons relative to the speed of the field crew necessitated the placement of 14 plots.

Within the study area, our stratified randomly located plots were generated using GIS software ArcMap with the Create Random Points tool.

[11] (Dick-Peddie, 1993) p 92

Field Methods

On these 14 plots, the NMFWRI crew followed the Department of Interior's FEAT/FIREMON Integrated (FFI) sampling protocols and used 1/10th acre fixed plots to assess tree size (diameter and height) and density (trees/acre).

Plot layout and setup

Plots are most efficiently accomplished with a 3-person crew but can also be taken with 2 people.

Plots are established using a random point location with project-specific boundaries e.g. stand boundaries, treatment areas, vegetation types, etc. Maps and plot locations are generated with ArcGIS utilities and are loaded onto a Trimble and Garmin GPS units. Upon arrival at the point (navigation is typically accomplished through paper maps and the Garmin GPS units), the Trimble unit is used to accurately determine plot location. A marker (we typically use a 1-foot piece of ½ inch rebar) is slammed into the ground and capped, to serve as plot center. The Trimble unit is used to collect updated plot location coordinates which are later post-processed using Pathfinder Office software for greater location accuracy. Plots must be moved one chain (66 ft) from their original, intended location if they are within 75 feet of a road.

Our plots are set up using 8 pin flags. Crew members walk cardinal azimuths (N, E, S, W) from plot center and place pin flags at 11.78ft (11' 9") and 37.24ft (37' 3") to give visual aids for the two plots (1/10th ac and 1/100th ac) whose purposes are described below.

Photographs & Other Plot data

Seven photographs are taken per plot. Typically, a white board with marker is used to tag each photo. The first photo taken at each plot is of the white board on the ground at plot center ("PC"). This ensures the data technicians are able to read the plot name and number and correctly identify the photos that follow. Additional photos include: "C," taken from 75 feet along the North azimuth looking at a crew member holding the white board at plot center, the Brown's transect photo, "B" taken from the random fuels azimuth looking at a crew member holding the white board at plot center, and "N," "E," "S," and "W" photos taken from plot center facing a crew member holding the white board 37.2' at each of the four cardinal azimuths. Additional photographs may be taken, but we recommend these be taken after the mandatory seven plot photos, and noted on the data sheets, so that there is no confusion for the data technicians.

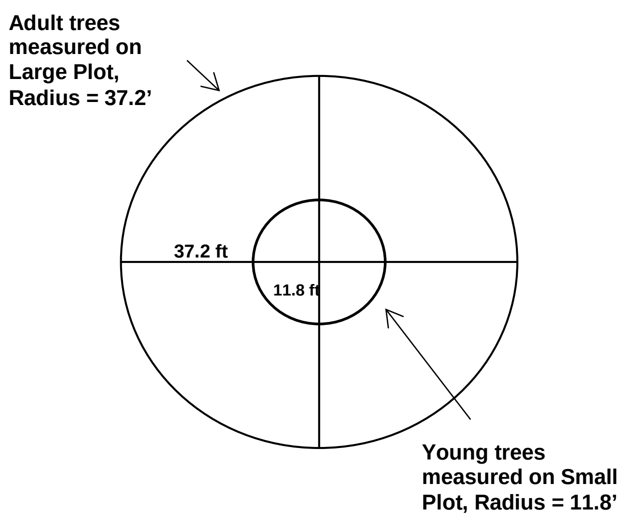
Slope, aspect, coordinates, elevation, date, and time are recorded for each plot. Comment fields are available on all datasheets and we encourage all observations, including species, land use impacts, fire history, challenges in taking plot, etc to be documented here.

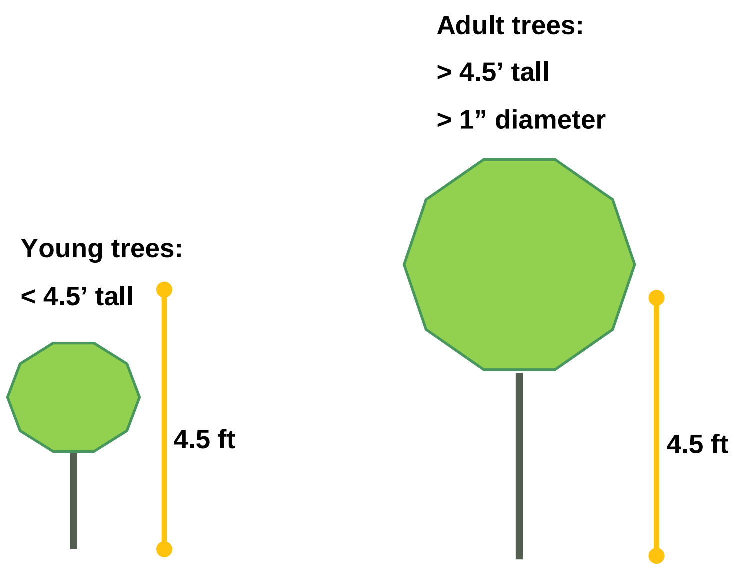
Overstory

All trees taller than breast height (≥ 4.5 ft. and > 1.0 in dbh or drc, depending on species) are measured within the 1/10th acre plot (37.24 ft. radius) circular, fixed area sampling plot. Species, condition, diameter at breast height (dbh) for single stem species, diameter at root collar (drc) for multi-stem species (i.e. *Quercus* spp., *Juniperus* spp.), total height, and live crown base height are recorded for each tree located within the plot. Trees are recorded starting from the north azimuth line and moving clockwise, like spokes of a wheel from plot center. In dense stands, we find it helpful to flag the first tree measured to keep the crew oriented.

Tree regeneration (trees < 4.5 ft. or <1.0 in dbh/drc) is measured on a nested 1/100th acre circular plot (11.78 ft. radius) and species, condition, and height class (>0-0.5 ft; >0.5-1.5ft; >1.5-2.5ft; >2.5-3.5ft.; >3.5-4.5ft; and <4.5ft but <1.0in dbh/drc) are recorded for each seedling or sprout. Shrubs are measured on the same nested subplot and species, condition and height class (0-0.5 ft; >0.5-1.5ft; >1.5-2.5ft; >2.5-3.5ft.; >3.5-4.5ft) are recorded for each stem. Canopy cover (density) is measured facing out at the four small-plot pin flags, along the perimeter of the nested subplot, using a spherical densitometer. In this way, each reading is spaced 90 degrees apart.

Trees and shrubs are typically recorded using their USDA PLANTS code, which is commonly a four letter code defined by the first two letters of the genus and first two letters of the species name (e.g. Ponderosa pine, whose genus and species is *Pinus ponderosa* becomes PIPO; oneseed juniper, whose genus and species is *Juniperus monosperma* becomes JUMO, etc).



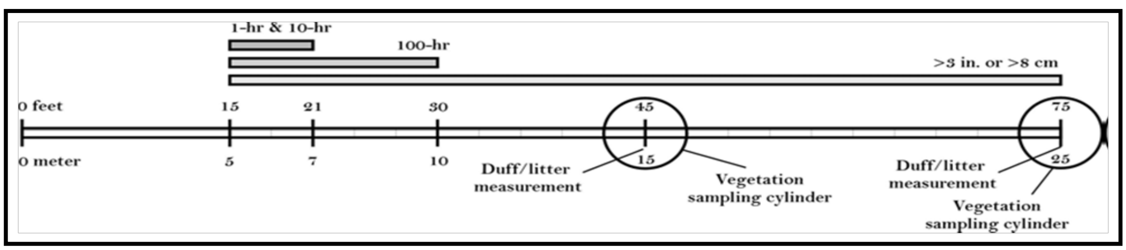


Fuels (Brown's)

Dead woody biomass and forest floor depth are measured using one 60 ft. planar Brown's transect (Brown 1974) located at a random azimuth. (Typically, one crew member spins a compass and another decides when to stop.) The tape is run from the plot center stake out 75 feet and the transect is measured from 15 to 75 feet to account for the expected foot traffic disturbance around plot center. Parameters measured include 1, 10, 100, and 1,000 hour fuels (also called "time-lag fuels"). For more information, see Brown 1974. Note that in our protocol, a piece of coarse woody debris (CWD) must be >3" in diameter and at least 3 feet long to count as a 1000-hour fuel; if it is >3" in diameter, but under 3 feet long, we count it as a 100-hour fuel.

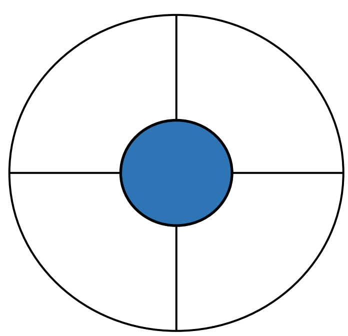
Percent cover and height of herbaceous live and dead material, percentage cover and height (up to 6 ft.) of woody live (excluding boles of trees) and dead material are estimated using the planar intersect method at 45 and 75 ft (Brown 1974). Litter and duff depths are measured at 45 and 75 ft.

A photograph is taken at each Brown's transect from the 75 foot mark facing plot center, and slope is taken along the transect.



Understory

Vegetation and ground cover is estimated within the nested 1/100th acre plot. Vegetation measurements include aerial percent cover of seedling/saplings, shrubs, graminoids, and forbs, and may not total 100%. Ground cover measurements include percentage of plant basal area (includes cacti), boles, litter, bare soil, rock, and gravel, and must total 100%.



Additional information can be found in the 2008 document authored by Derr, et. al., *Monitoring The Long Term Ecological Impacts Of New Mexico's Collaborative Forest Restoration Program, New Mexico Forest Restoration Series Working Paper 5*.

All raw data and photo points will be provided to the land managers upon request; the goal of this report is to summarize the monitoring results in a concise manner. Note that in our study, piñon and juniper with more than 2 stems or whose branch structure made access difficult were measured at root collar (DRC) instead of breast height (DBH). Therefore, some portions of our data analysis include basal areas of piñon, juniper, and oak estimated from root collar diameters conversions using equations developed by Chojnacky and Roger (1999).

All results are typically reported to 2 significant digits, with exceptions for those metrics we know were measured with either more or less precision.

Disclaimer

NMFWRI provides this report and the data collected with the disclaimer that the information contained in these data is dynamic and may change over time. The data are not better than the original sources from which they were derived. It is the responsibility of the data user to use the data appropriately and within the limitations of monitoring data in general, and these data in particular. NMFWRI gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data. These data and related graphics are not legal documents and are not intended to be used as such. This includes but is not limited to using these data as the primary basis for the development of thinning prescriptions or especially timber sales. NMFWRI shall not be held liable for improper or incorrect use of the data described and/or contained in this report.

Personnel Involved

2016 New Mexico Forest and Watershed Restoration Institute Monitoring Team:

- Kathryn Mahan, ecological monitoring specialist
- Daniel Hernandez, ecological monitoring technician

2016 New Mexico Forest and Watershed Restoration Institute GIS Team:

- Patti Dappen, GIS Specialist

Other persons contacted:

- Fred Rossbach, Field Coordinator, Greater Rio Grande Watershed Alliance
- Grant Mitchell, San Cristobal Ranch Manager

San Cristobal PJ Project (16-10) Description

Project 16-10 is located on the San Cristobal Ranch, in Santa Fe County, south of Lamy, NM.

The nearby city of Santa Fe receives an average of 14.21 inches of precipitation per year. The average high temperature is 86° F in July and the average low is 17° F in December and January[12]. According to the NRCS Web Soil Survey, the two polygons of the project area together are comprised of 58% Kech-Cerropelon-Rock outcrop complex 5 to 50 percent slopes, 30% Penistaja family-Truehill complex, 6.6% Oelop-Charalito complex, 1 to 3 percent slopes, 2.7% Zia-Gullied land complex, 2 to 10 percent slopes, 2.6% Penistaja family loam, 3 to 8 percent slopes, and trace amounts of Arents-Urban land-orthents

[12] (U.S. Climate Data, 2017)

complex, 1 to 60 percent slopes. Ecological sites within this project include R035XA112NM Loamy, R035XG114NM Gravelly, R035XG121NM Shallow Sandstone, and R035XG122NM Sandstone Hills.[13]

The Loamy ecological site typically supports a grassland state dominated by blue grama, western wheatgrass, galleta, ring muhly, dropseeds, and/or threeawns. It can also be found in a piñon-juniper invaded state (dominated by piñon, juniper, and blue grama), a grass/succulent-mix state (dominated by blue grama, cholla and prickly pear), a shrub-dominated state (dominated by rabbitbrush or horsebrush and blue grama), as well as a bare state with sparse grass.[14]

The Gravelly ecological site type typically supports grassland with minor shrub and piñon-juniper components. Common dominant grass species include blue, black and sideoats grama, little bluestem, spike muhly, Western wheatgrass, New Mexico feathergrass, Indian ricegrass, and squirreltail. Common shrubs include fourwing saltbush, winterfat, Apache plume, rabbitbrush, soapweed yucca, sagebrush and broom snakeweed. The site can also be found in a shrub-encroached state dominated by rabbitbrush and blue grama; erosion is more common in this state.[15]

The Shallow Sandstone ecological site type is dominated by grasses such as sideoats grama, blue grama, little bluestem, Indian ricegrass, New Mexico feathergrass, and galleta. Shrubs found in this site type include Bigelow sagebrush and fourwing saltbush. Other common shrubs include sand sagebrush, rubber rabbitbrush, winterfat, and mountain mahogany. In its reference condition, piñon and juniper are scattered across this site type; however, grasses are dominant with uniform cover and few large bare areas present. Scattered shrubs and trees may comprise a canopy cover averaging 10%. Evidence of erosion such as pedestalling of grasses, rills and gullies is infrequent. Sideoats grama, little bluestem, many cool-season grasses, mountain mahogany, and winterfat typically decrease in response to overgrazing resulting in a blue-grama galleta community or even a piñon-juniper dominated community when overgrazing is combined with fire suppression/lack of fine fuels and mild summers paired with wet winters which favor juniper establishment.[16]

The Sandstone Hills ecological site type is typically a characterized by a mixture of warm and cool season grasses, shrubs, and scattered trees. Grasses include sideoats grama, blue grama, little bluestem, Indian ricegrass, New Mexico feathergrass, galleta, and sometimes black grama. Threeawns and hairy grama can also dominate. Shrubs found in this site type include skunkbrush sumac, oak, mountain mahogany, and winterfat; trees include piñon and juniper. The site can also become encroached by piñon and juniper with a loss of grass cover due to water and wind erosion, as well as overgrazing and lack of fire. An eroded state is also possible if these processes continue, in which tree and shrubs dominate and grass is sparse; restoration efforts are difficult at point due to steep slopes, soil degradation and lack of precipitation.[17]

Monitoring was conducted at this 174-acre site on November 21-22, 2016 as a forest and watershed health treatment to reduce the tree cover in a piñon-juniper savanna/woodland. The project is located on the San Cristobal Ranch, in Santa Fe County, south of Lamy, NM. The project area is in a

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13 (USDA NRCS, 2013)
14 (USDA NRCS, n.d.)
15 (USDA NRCS, n.d.)
16 (USDA NRCS, n.d.)
17 (USDA NRCS, n.d.)

juniper/piñon savanna/woodland above and eventually draining into the San Cristobal Arroyo. It is accessed off US Hwy 285 and private ranch roads. The Santa Fe-Pojoaque Soil and Water Conservation District (SFPSWCD) sponsored the project. The project is a forest health treatment to create a more open grassland savanna and restore the area vegetation to historic conditions. The project will remove most of the juniper trees and some of the piñon trees to create large, open, patchy grassland; the wood may be salvaged for firewood. There is an emphasis on creating large patches of open areas. Several rocky outcropping are present within the project, as are incised drainages (some of which have been partially filled with slash and debris by the ranch). The project goals are to reduce the density of trees, reduce soil erosion, increase forage for wildlife and grazing, promote natural hydraulic processes include water percolation into the soil and potential for increase water flow, and overall, increase ecosystem function and health.

16-10 San Cristobal PJ

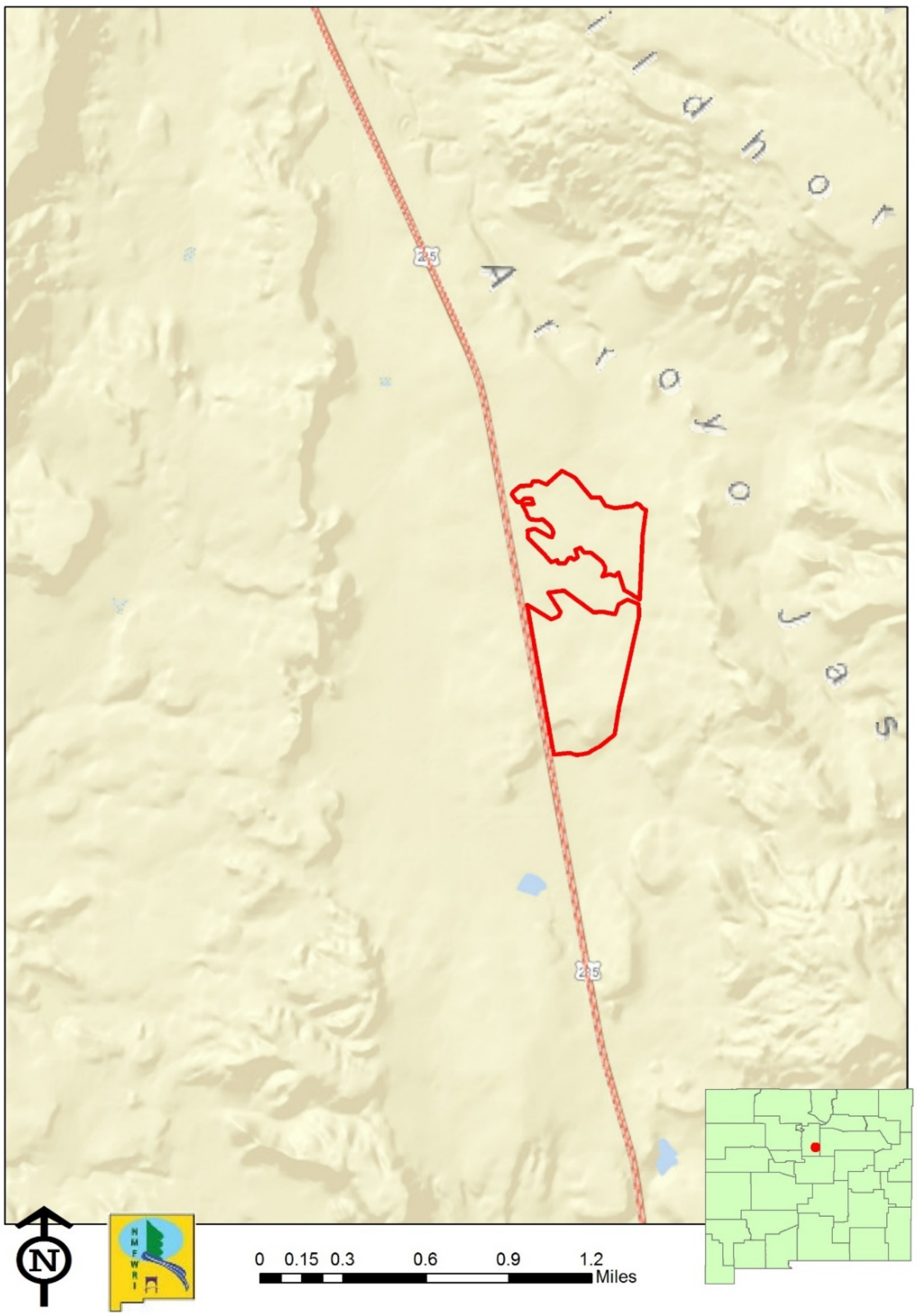


Figure 1. Project 16-10 in geographic context.

The SFPSWCD 2016/2017 GRGWA site 16-10 is located adjacent to Highway 285 at around 6500 feet. Russian thistle (tumbleweed) was observed on plots, as well as blowing through and collecting against juniper trees. Dominant natives observed at the time of the site visit included cholla, blue grama, juniper, piñon, broom snakeweed, and mountain mahogany.

Monitoring Results

We randomly placed 14 plots on slopes ranging from 1% to 20%, with an average of 5%. Aspect on plots was distributed 29% North, 36% East, 21% South, and 14% West.

16-10 San Cristobal PJ North Section Monitoring Plots

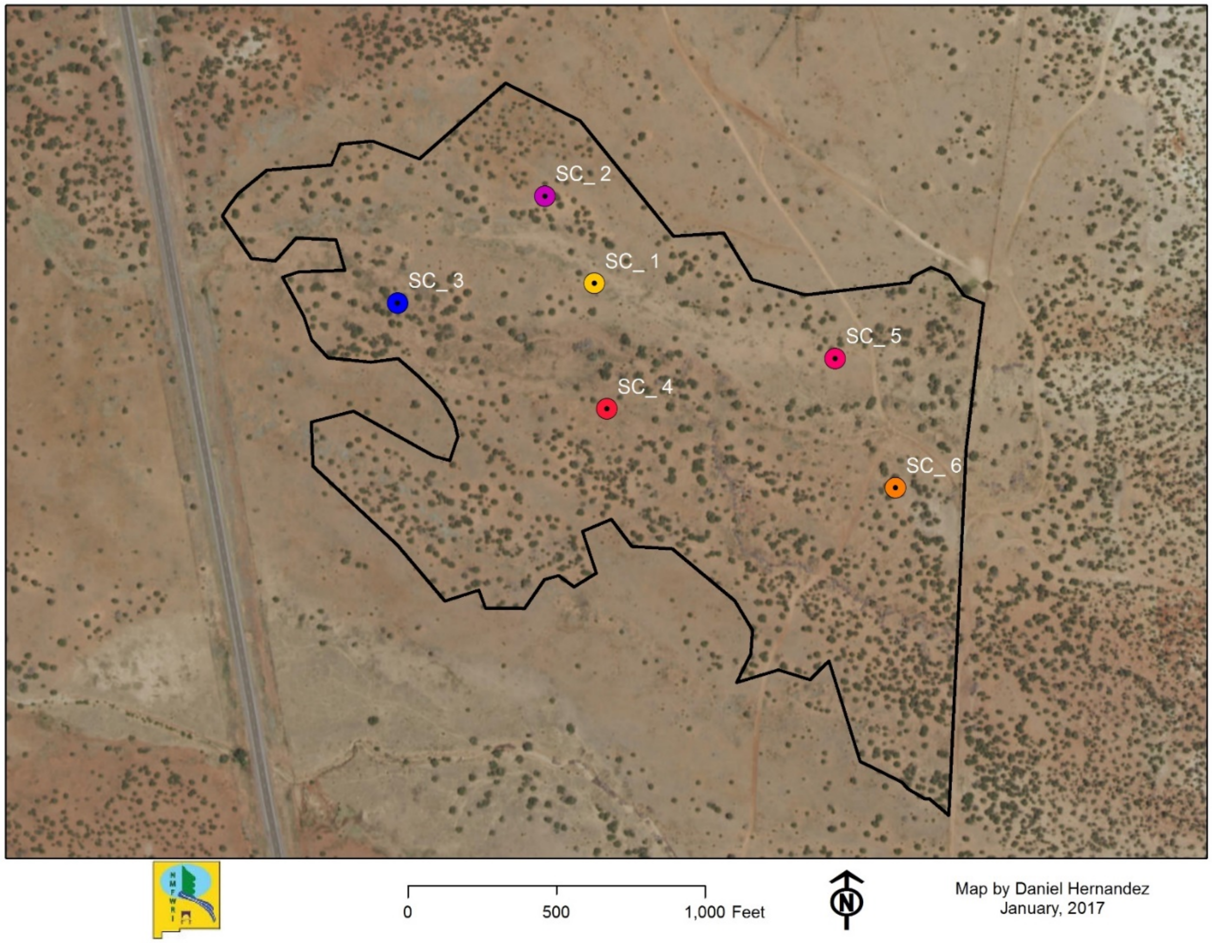


Figure 2. 16-10 San Cristobal PJ North Section Monitoring Plots.

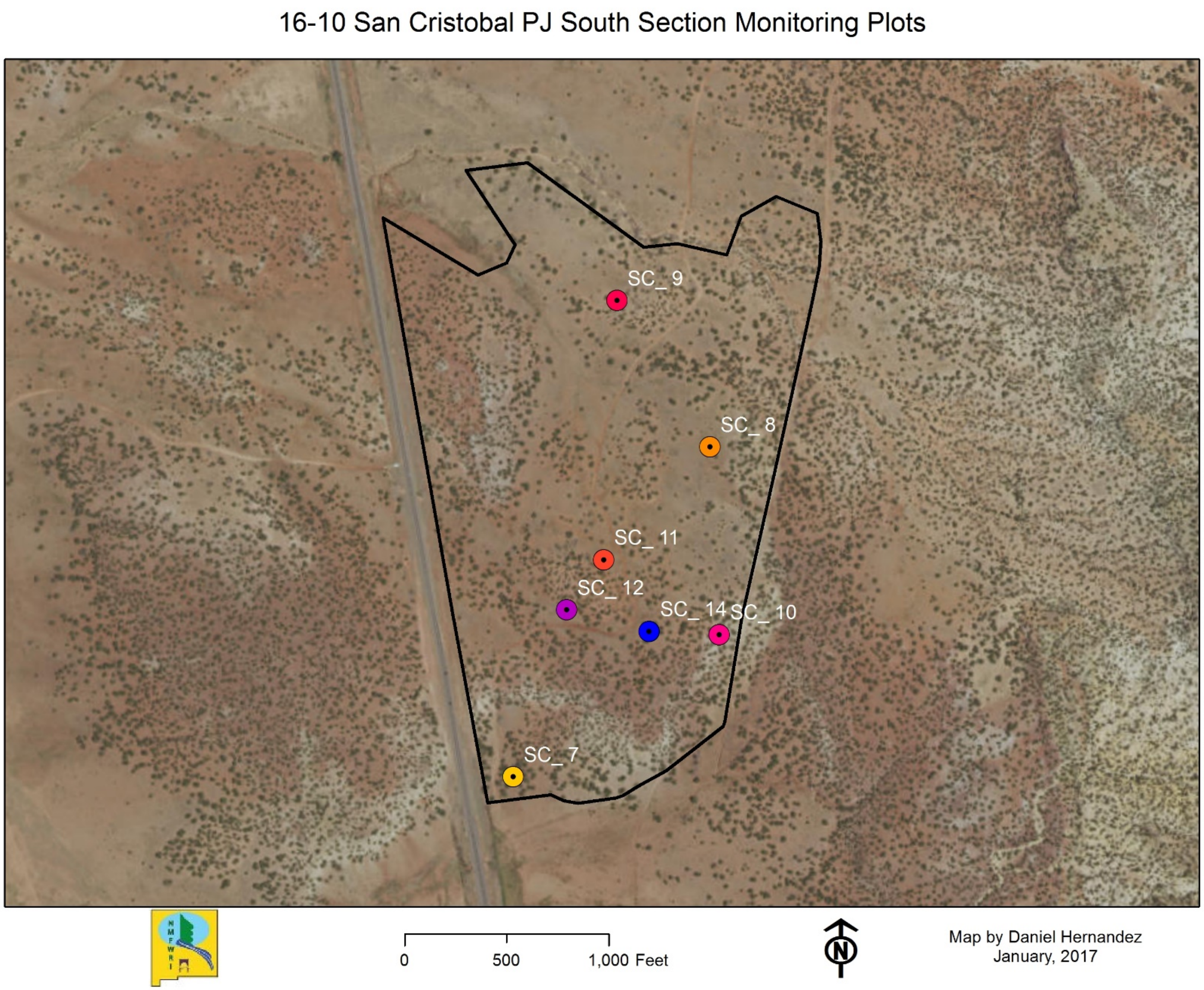
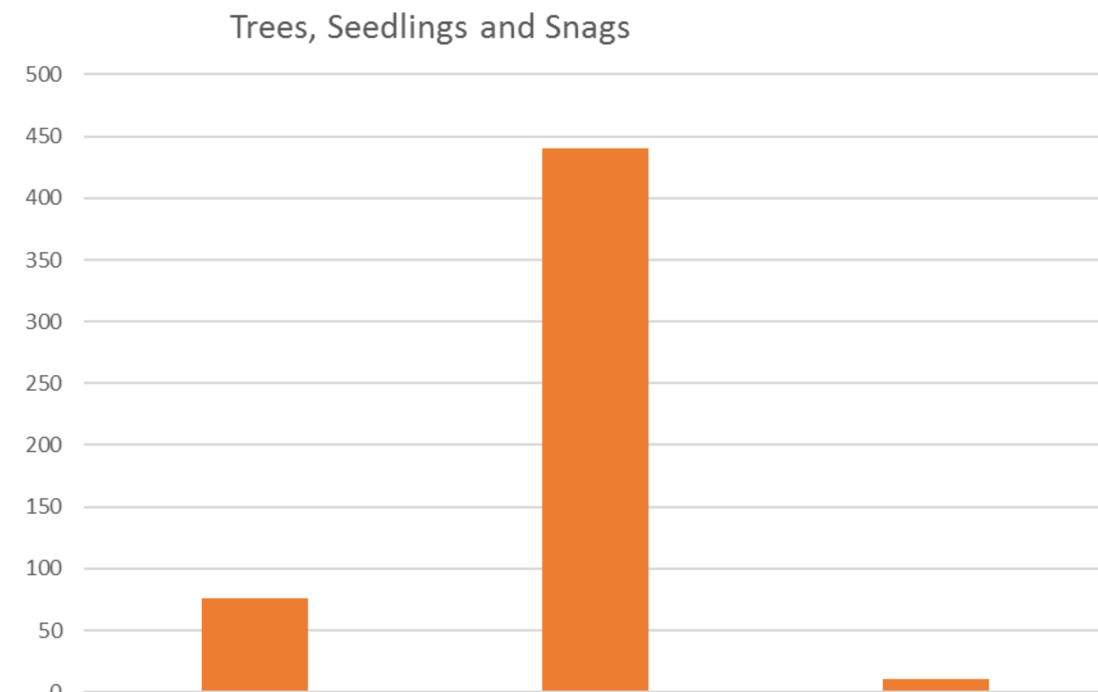


Figure 3. 16-10 San Cristobal PJ South Section Monitoring Plots.

Tree Component

Among these plots, the average number of trees per acre (TPA) was 76 (Figure 4). The average basal area was 38 ft^2/acre (not shown on graph). Tree heights averaged 8.9 feet, live crown base height averaged 0.7 feet, and the quadratic mean diameter (QMD) was 10.1 inches (Figure 5). Average species distribution among trees was as follows: 57 oneseed juniper/acre, and 19 piñon/acre (Figure 6). Average height, QMD, and live crown base height (LiCrBHt) are displayed by species in Table 1, below.



	TPA	Seedlings/acre	Snags/acre
16-10 San Cristobal PJ	76	440	11

Figure 4. Trees, Seedlings, and Snags per acre for 16-10.

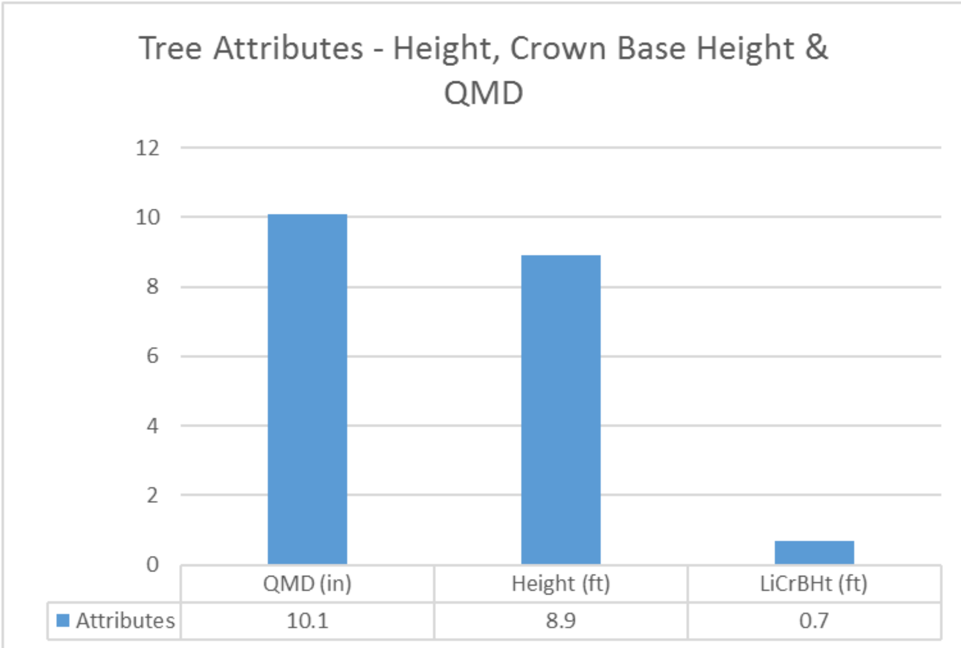


Figure 5. Height, Crown Base & QMD .

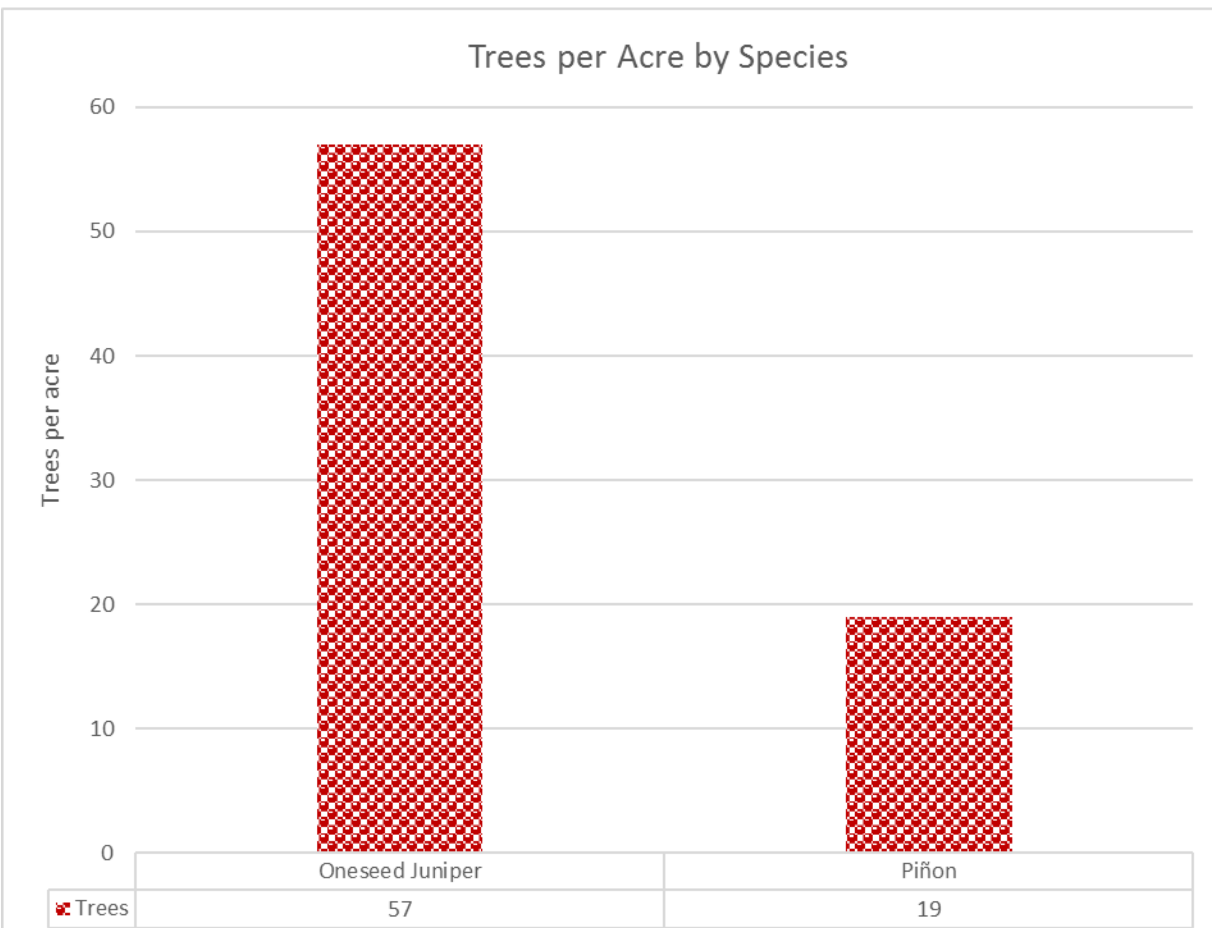


Figure 6. TPA by species for 16-10.

Table 1. Average height, QMD and LiCrBHt of 16-10.

Plots	Species	QMD (in)	Avg Ht (ft)	Avg LiCrBHt (ft)
Pre-treatment	Piñon	3.3	10	1.2
(14 plots)	Oneseed juniper	10.8	8.8	0.6

Number of stems was also recorded for each tree. It was common for juniper species in particular to have multiple stems, up to 23. Occasionally, trees had both live and dead stems present. See Figure 7 for more information.

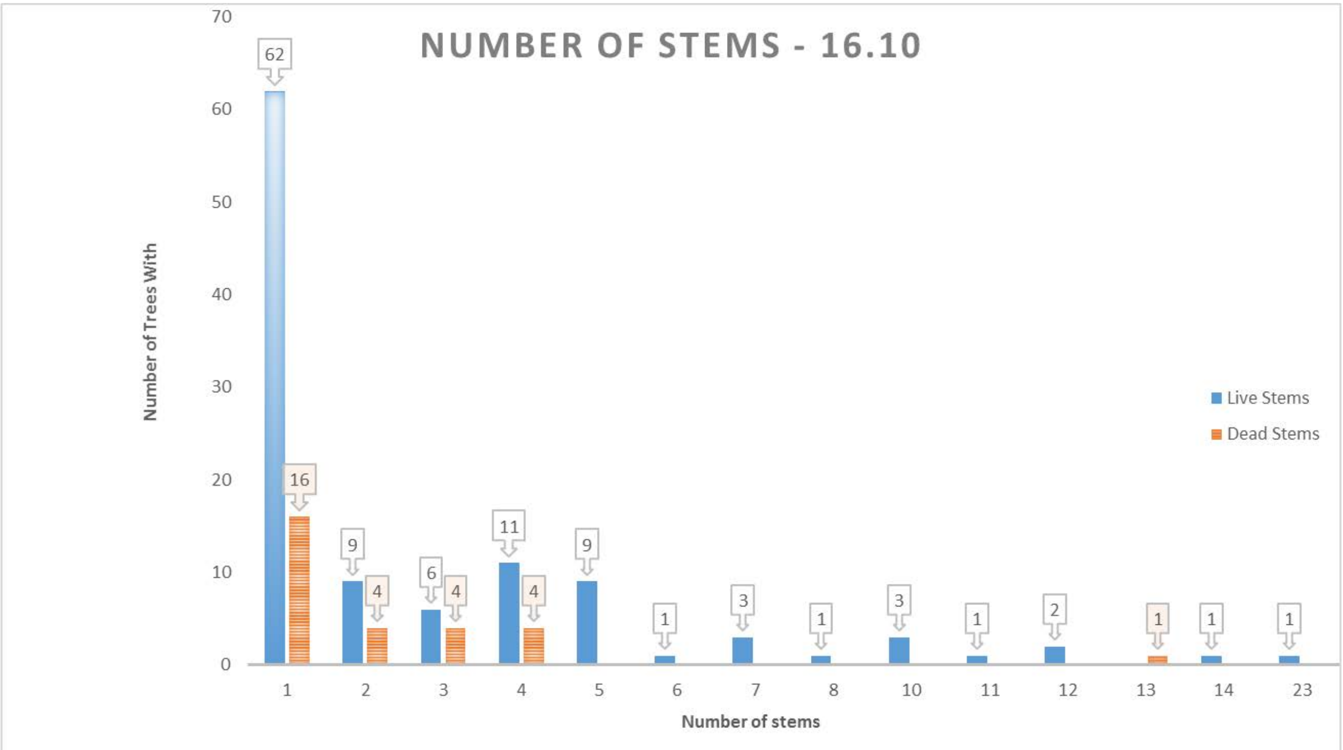


Figure 7. Number of live and dead stems on trees for 16-10.

Note that some trees, such as those displaying brown needles, severe injury or insect damage, or with high proportions of dead stems to live stems, were classified by the field crew as “sick,” meaning they were not expected to recover/survive. Of these trees, 100% were oneseed juniper.

These plots averaged 10 snags (standing dead trees) per acre. 71% of these snags were oneseed juniper, and 29% were piñon.

The plots had an average of 71 tree seedlings per acre. Of these, piñon was encountered at 7.1 individuals per acre and Rocky Mountain juniper at 64 individuals per acre (Figure 8).

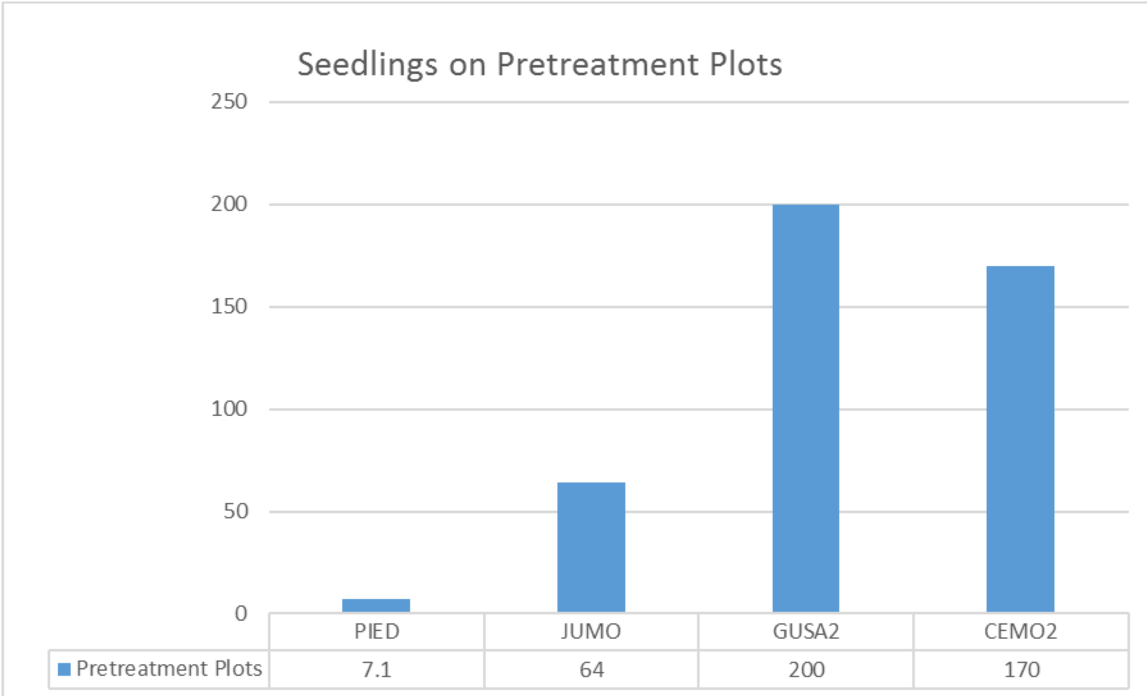


Figure 8. Seedlings per acre by species for 16-10.

No saplings were observed on any plots.

Shrub (and cacti) species were also recorded during small plot inventory; these results can be found in Figure 9.

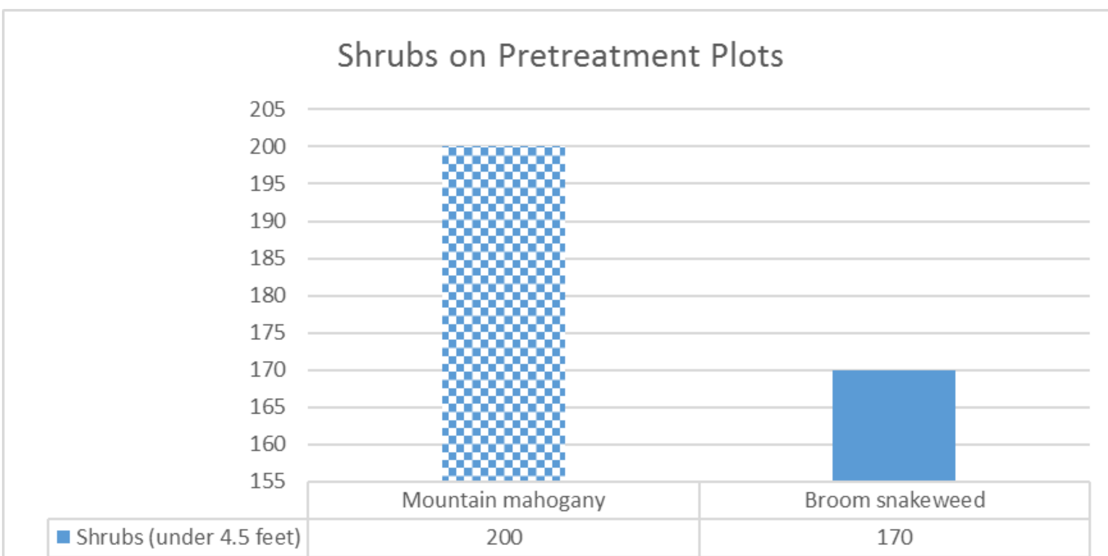


Figure 9. Shrubs per acre by species for 16-10.

Stand tables and plot summaries for all plots can be found in Table 2 through Figure 6 below.

Table 2. Summary table for all plots.

16-10 San Cristobal PJ			February 2017		
Summary Table for all Plots			**# Sample Trees on plot**	**Trees per acre**	**Basal area per acre**
Plot Total			**125.00**	**89.29**	**40.33**
Growing Stock		Healthy (H)	0.00	0.00	0.00
		Unhealthy(U)	0.00	0.00	0.00
		Sick (S)	10.00	7.14	6.02
		Living (L)	100.00	71.43	32.23
Sum of Growing Stock			**110.00**	**78.57**	**38.25**
Dead		Dead (D)	15.00	10.71	2.08
Sum of Dead			**15.00**	**10.71**	**2.08**
Plot Total: Growing Stock & Dead		**Sum of**	**125.00**	**89.29**	**40.33**

Table 3. Individual plot summaries for all plots.

16-10 San Cristobal PJ				
Individual Plot Summary Table				
		Growing Stock		
Macro Plot Name	Total number of sample trees on plot	Number of growing stock sample trees on plot	Trees per Acre	Basal Area per Acre
SC_1	1	1	10	17.40
SC_2	6	5	50	24.69
SC_3	5	4	40	30.81
SC_4	2	1	10	4.29
SC_5	2	2	20	34.10
SC_6	17	17	170	127.18
SC_7	13	13	130	80.88
SC_8	2	2	20	2.44
SC_9	17	13	130	43.24
SC_10	11	10	100	79.12
SC_11	6	4	40	10.36
SC_12	9	8	80	33.70
SC_13	29	25	250	25.61
SC_14	5	5	50	21.65
Total	**Total number of sample trees on plot**	**Number of growing stock sample trees on plot**	**Average for all Plots**	
			TPA	**BA/AC**
	125.00	**110.00**	**78.57**	**38.25**

Table 4. Woodland species stand table for all plots.

Stand Table					16-10 San Cristobal PJ			2016/2017												
Woodland Species		Saplings			Pole			Mature Trees											Total by Species	%Species for all G-Stock
Diameter Class		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32+		
PIED	COUNT	6	11	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	27.00	
Pinon pine	TPA	4.29	7.86	5.00	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.29	25.23%
	BA/AC	0.01	0.13	0.40	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.62%
	AVE HT. (HL)	7	9	12	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
JUMO	COUNT	1	10	12	12	10	9	5	6	2	8	3	0	1	1	0	0	0	80.00	
One-seed juniper	TPA	0.71	7.14	8.57	8.57	7.14	6.43	3.57	4.29	1.43	5.71	2.14	0.00	0.71	0.71	0.00	0.00	0.00	57.14	74.77%
	BA/AC	0.00	0.18	0.80	1.83	2.45	3.40	2.87	4.48	1.90	9.85	4.88	0.00	2.17	2.44	0.00	0.00	0.00	37.25	97.38%
	AVE HT. (HL)	6	7	8	8	9	11	11	11	12	11	13	0.00	12	15	0.00	0.00	0.00		
Woodland	*COUNT*	*7*	*21*	*19*	*15*	*10*	*9*	*5*	*6*	*2*	*8*	*3*	*0*	*1*	*1*	*0*	*0*	*0*	*107.00*	
Species Sub-total	*TPA*	*5.00*	*15.00*	*13.57*	*10.71*	*7.14*	*6.43*	*3.57*	*4.29*	*1.43*	*5.71*	*2.14*	*0.00*	*0.71*	*0.71*	*0.00*	*0.00*	*0.00*	*76.43*	*100.00%*
	BA/AC	*0.01*	*0.31*	*1.20*	*2.29*	*2.45*	*3.40*	*2.87*	*4.48*	*1.90*	*9.85*	*4.88*	*0.00*	*2.17*	*2.44*	*0.00*	*0.00*	*0.00*	*38.25*	*100.00%*
	AVE HT. (HL)	*7*	*8*	*10*	*9*	*9*	*11*	*11*	*11*	*12*	*11*	*13*	*0.00*	*12*	*15*	*0.00*	*0.00*	*0.00*		
Summary by Size	*TPA*	*33.57*			*24.29*			*18.57*											*76.43*	
Class for	*TPA %*	*43.93%*			*31.78%*			*24.30%*											*100.00%*	
Woodland	*BA/AC*	*1.52*			*8.14*			*28.59*											*38.25*	
Species	*BA/AC %*	*3.97%*			*21.28%*			*74.74%*											*100.00%*	
	QUADRATIC MEAN DIA.	*2.88*			*7.84*			*16.80*											*9.58*	
	AVE HT. (HL)	*9*			*10*			*12*											*11*	

Understory and Forest Floor Components

As described above, percent ground cover was estimated at each plot within the 1/100th acre subplot. Tree canopy was measured with a densiometer. Where total percent cover exceeds 100%, this is usually due to the presence of litter beneath other vegetation.

Average cover values were as follows: 22% tree canopy cover, 7.2% seedling/sapling cover, 10% shrub cover, 52% graminoid and forb cover, 22% litter cover, 7.5% rock and gravel cover, and 38% bare soil. See Table 5. As expected, cover values varied by plot; for example, individual plot measurements of tree canopy cover ranged from 0% to 73%.

Table 5. Tree canopy, understory and ground cover for 16-10.

16.10 San Cristobal	**Aerial Cover**			
Tree Canopy	**Tree Regen**	**Shrubs**	**Gramanoid**	**Forbs**
22%	7.2%	10%	40%	12%

Ground Cover					
Plant basal	**Bole**	**Litter**	**Bare soil**	**Rock**	**Gravel**
27%	4.9%	22%	38%	2.7%	4.8%

Additional cover data was collected using the planar intercept method as revised by Brown (1974) for the sampling of down woody debris (DWD) and ladder fuels, which was described in the Field Methods section. Recall that this data is broken down into four categories: herbaceous dead (HD), herbaceous live (HL), woody standing dead (SD), and woody standing live (SL). The average total percent cover for all plots was 14%. Average HD cover was 39%, average HL cover was 4.6%, SD cover was 3.8%, and SL was 6.4%. See Table 6, below.

Table 6. Planar intercept cover and fuels for 16-10.

Fuel	**Avg Cover %**	**Avg Ht (ft)**	**Avg Biomass (tons/ac)**	**Total biomass (tons)**
HD	39	0.4	0.4	5.5
HL	4.6	0.2	0	0.67
SD	3.8	0.1	0	0.48
SL	6.4	0.2	0.1	0.99
TOTAL (AVG)	13.5	0.2	0.1	1.9
TOTAL (SUM)	*53.8*	*0.9*	*0.5*	*7.6*

Surface fuels were measured at all plots using Brown's transects. Average tons/acre for all fuels (1, 10, 100, and 1000-hour wood fuels as well as litter and duff) was 4.9. Total wood fuels were measured at 1.3 tons/acre with fine wood fuels (1 to 100 hour fuels) measured at an average of 1.0 tons/acre and coarse wood fuels (1000-hour fuels) at 0.30 tons/acre. Duff was measured at 0.57 tons/acre and an average depth 0.06 inches; litter was measured at 3.0 tons/acre and an average depth of 0.60 inches. See Table 7.

Decay classes of logs (1000-hour fuels) were recorded (Figure 10). The absence of any logs in decay class 1-3 and the concentration of logs in decay classes 4 and 5 suggests that snags are not becoming logs at a high rate. Both snags and logs provide wildlife habitat and are an important part of a restored landscape.

Table 7. Surface fuels for all plots.

16-10 SC PJ	
Fuel	**Avg Tons/Ac**
1-Hour	0.10
10-Hour	0.63
100-Hour	0.30
1000-Hour	0.3
Duff	0.57
Litter	3.0
TOTAL FINE WOOD FUELS	1.00
TOTAL WOOD FUELS	1.30
TOTAL SURFACE FUELS	4.90
Fuel	**Depth (inches)**
Duff	0.06
Litter	0.60
TOTAL DEPTH	0.66

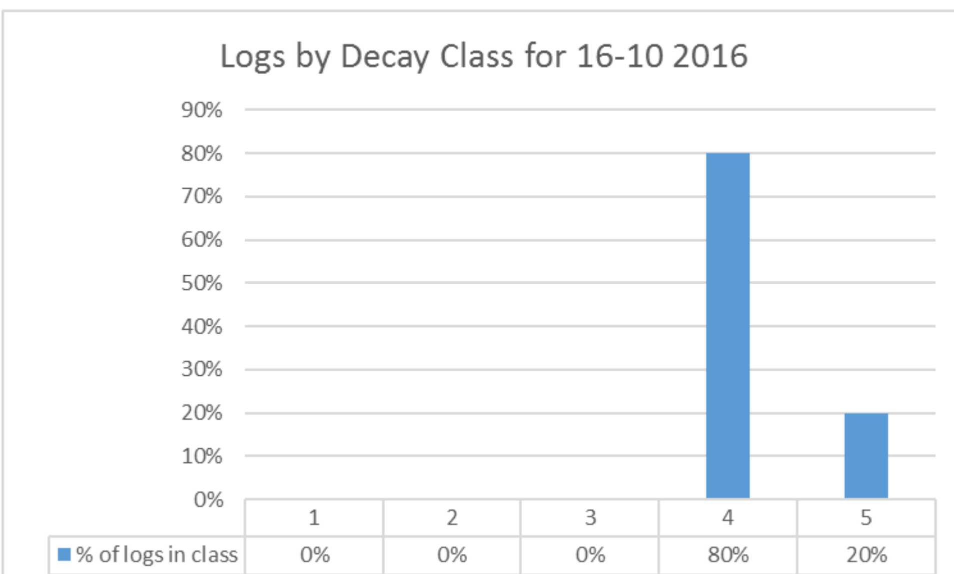


Figure 10. Logs (1000-hour fuels) by decay class for 16-10.

Summary

The following table outlines a summary of 2016 pretreatment conditions for this site.

Table 8. Data summary for all 16-10 plots.

Metric	Average (if applicable)	Range of values on individual plots (if applicable)
Trees per acre	76	10 - 250
Dominant tree (numerically)	oneseed juniper	---
Basal area (ft^2/acre)	38	2.4 - 130
QMD (inches)	10.1	0.1 – 25 (DBH on individual trees)
Average tree height (ft)	8.9	5.5-11
Height of tallest tree (ft)	17 (piñon)	----
Average LiCrBHt (ft)	0.7	0-3.8
Seedlings per acre	71	0 - 700
Dominant seedling (numerically)	Oneseed juniper	----
Saplings per acre	0	0
Dominant sapling (numerically)	----	-----
Shrubs per acre (in seedling ht class)	370	0 - 2400
Dominant shrub (numerically)	Mountain mahogany	----
Shrubs per acre (in sapling ht class)	0	
Dominant shrub (numerically)	----	-----
Sick trees per acre	7.1	0 - 30
Dominant sick tree (numerically)	Oneseed juniper	----
Snags per acre	10	0 - 80
Dominant snag (numerically)	Oneseed juniper	----
Average slope (%)	5%	1-20%
Dominant aspect	East (36%)	North, East, South, West
Canopy cover (%)	22%	0-73%
Grass and forb cover (%)	52%	0-90%
Average total tons of surface fuel per acre	4.9	0-4.5

Next Steps (Monitoring)

The goal of the GRGWA/ NMFWRI is that all sites will be revisited for post-treatment monitoring in 5-year intervals. It is our intention and expectation that the data collected in these intervals will reflect any significant changes in disturbance and ecological function of the site.

References

Brown, J. K. (1974). Handbook for Inventorying Downed Woody Material, USDA Forest Service General Technical report INT-16. *Handbook for Inventorying Downed Woody Material*. Ogden, Utah: USDA Forest Serivce Intermountain Forest and Range Experiment Station.

Claunch-Pinto Soil and Water Conservation District on behalf of the Greater Rio Grande Watershed Aliance. (2016). *Request for Proposals for Greater Rio Grande Watershed Alliance Riparian Restoration Projects.* Mountainair, NM: Claunch-Pinto Soil and Water Conservation District.

Dick-Peddie, W. A. (1993). *New Mexico Vegetation: Past, Present and Future.* Albuquerque: University of New Mexico Press.

Lightfoot, D. &. (2012). *Greater Rio Grande Watershed Alliance Riparian Restoration Effectiveness Monitoring Plan.* Albuquerque, NM: SWCA Environmental Consultants.

Lightfoot, David & Stropki, C. (2012). *Field Manual for Greater Rio Grande Watershed Alliance Riparian Restoration Effectiveness Monitoring.* Albuquerque, NM: SWCA Environmental Consultants.

National Park Service. (2015). *Pinyon-Juniper Woodlands: Introduction and Distribution*. Retrieved from NPS Articles: http://www.nps.gov/articles/pinyon-juniper-woodlands-distribution.htm

New Mexico Department of Cultural Affair Office of Archaeological Studies. (2014). *Pueblo San Cristóbal*. Retrieved from Galisteo Basin Archaeological Sites Protection Act: http://galisteo.nmarchaeology.org/sites/pueblo-san-cristobal.html

Pieper, Rex D. (2008). Ecology of Piñon-Juniper Vegetation in the Southwest and Great Basin. USDA Forest Service Proceedings RMRS-P-51. Retrieved 2017, from https://www.fs.fed.us/rm/pubs/rmrs_p051/rmrs_p051_003_010.pdf

U.S. Climate Data. (2017). *Climate New Mexico*. Retrieved from U.S. Climate Data: http://www.usclimatedata.com/climate/new-mexico/united-states/3201

USDA NRCS. (2013, December 6). *Web Soil Survey*. Retrieved from http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

USDA NRCS n.d. (n.d.). *Ecological Site Description Gravelly R035XG114NM .*

USDA NRCS n.d. (n.d.). *Ecological Site Description Loamy R035XA112NM .*

USDA NRCS n.d. (n.d.). *Ecological Site Description Sandstone Hills R035XG122NM .*

USDA NRCS. (n.d.). *Ecological Site Description Selection - New Mexico ESD Reports*. Retrieved from Ecological Site Information System: https://esis.sc.egov.usda.gov/Welcome/pgReportLocation.aspx?type=ESD

USDA NRCS n.d. (n.d.). *Ecological Site Description Shallow Sandstone R035XG121NM .*

Appendix I – Plot coordinates

Name	Latitude	Longitude
SC_ 1	35.323	-105.828
SC_ 2	35.323	-105.828
SC_ 3	35.322	-105.830
SC_ 4	35.321	-105.827
SC_ 5	35.322	-105.825
SC_ 6	35.321	-105.824
SC_ 7	35.310	-105.829
SC_ 8	35.314	-105.825
SC_ 9	35.316	-105.827
SC_ 10	35.312	-105.825
SC_ 11	35.313	-105.827
SC_ 12	35.312	-105.828
SC_ 13	35.317	-105.825
SC_ 14	35.312	-105.826

Appendix II - Photos

SC_2_B, taken facing 250 degrees from plot center.

SC_2_S, taken facing South from plot center.

SC_3_W, taken facing west from plot center.

SC_4_C, taken facing south toward plot center from 75 feet north.

SC_7_S, taken facing south from plot center.

SC_13_B, taken facing 227 degrees from plot center.