Pueblo of Acoma Horace Mesa Project 16-15

Pretreatment Monitoring Report

2017

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for the Greater Rio Grande Watershed Alliance

Lava 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 the Pueblo of Acoma's 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.

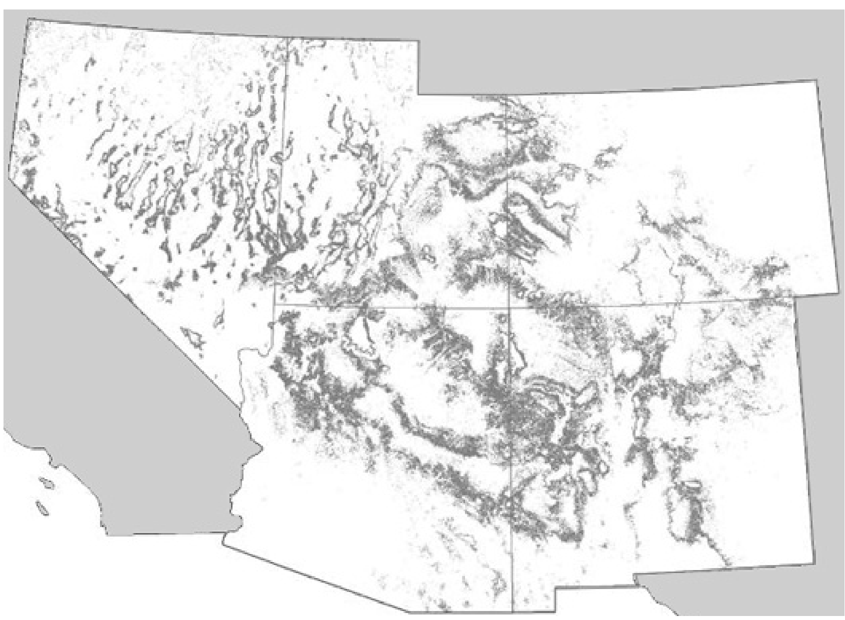

Figure 1. Piñon-Juniper distribution in NV, UT, CO, AZ and NM.[3]

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[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 the 16-15 Draft Project Description describes the purpose of the treatment as an improvement in watershed and forest health, reduction in hazardous fuels, and the creation of "a more open forest stat similar to historic levels." In addition it is expected that the treatment will increase grass cover for wildlife and grazing. The implications of Dick-Peddie's (and others') observations are that over time, with climate change, the site may not successfully maintain its more open structure and 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 4 plots distributed over 3 blocks: 1 plot in a 9.4-acre PJ Thin1 (also called Forested, or Medium Density, or 16-15a), 1 plot in 10.1-acre PJ Meadow1 and 2 plots in 35.7-acre PJ Meadow2 (these areas are analyzed together and may be called Meadow or Grassland or 16-15b). Each plot's location was established within the study area provided by Fred Rossbach on behalf from 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. In PJ Meadow2, which was 35.7 acres, time constraints on the window for fieldwork necessitated the placement of only two 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 4 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, and challenges in taking plot, etc to be documented here.

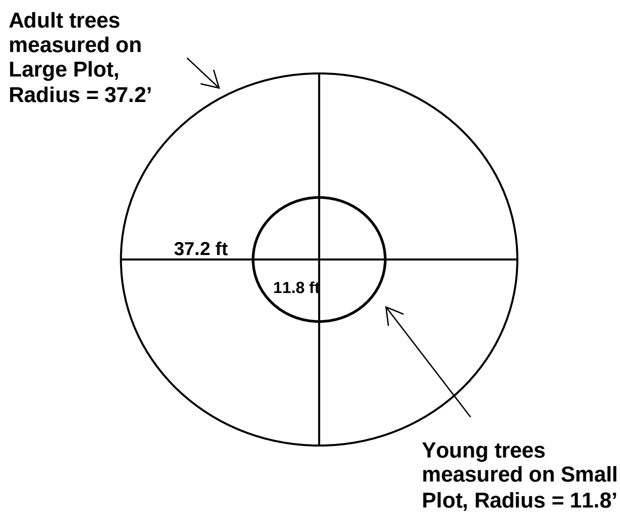
Overstory

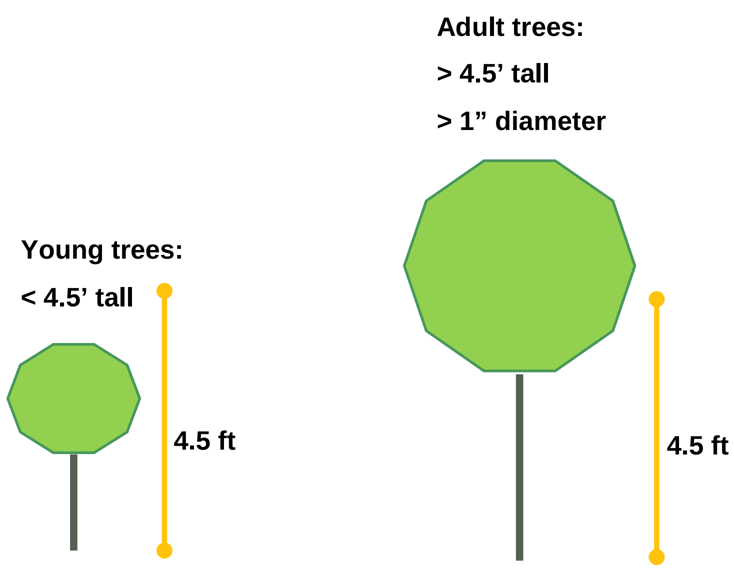
All trees taller than breast height (≥ 4.5 ft. and > 1.0 in dbh or drc, depending on species) are measured within the 1/10th acre plot (37.24 ft. radius) circular, fixed area sampling plot. Species, condition, diameter at breast height (dbh) for single stem species, diameter at root collar (drc) for 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. Witness trees may also be established in this manner to make the plot center easier to find in the future.

Tree regeneration is measured on the 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) are recorded for each seedling or sprout. Saplings (>4.5ft but <1.0in dbh/drc) are also recorded in this way. Shrubs are measured on the same nested subplot and species, condition and height/diameter class are recorded for each stem just as with tree species; cacti are typically recorded as well.

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). Note that upon entry into a database, it is common for these codes to be followed by various numbers in order to differentiate between other species whose names would create the same code. These symbols can be found on the USDA PLANTS website, https://plants.usda.gov/

Canopy cover (density) is an average of four measurements from a spherical densiometer. These four measurements are taken facing out at the four small-plot pin flags along the perimeter of the nested subplot. In this way, each reading is spaced 90 degrees apart.



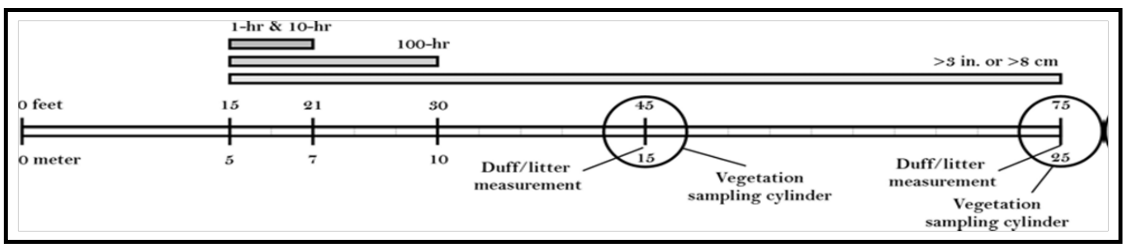


Fuels (Brown's)

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. Decay class (1 to 5) is also recorded.

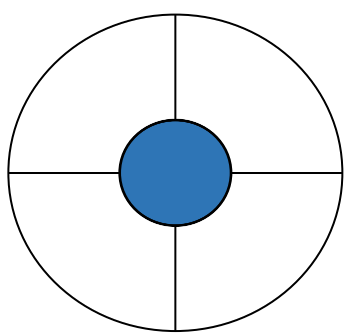
Percent cover and height of herbaceous live and dead material, percentage cover and height (up to 6 ft.) of woody live (excluding boles of trees) and dead material are estimated using the planar intersect method at 45 and 75 ft (Brown 1974). Litter and duff depths are measured at 45 and 75 ft.

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 are estimated within the nested 1/100th acre plot; some project managers may request these measurements are conducted across the entire 1/10th acre area. Vegetation measurements include aerial percent cover of seedling/saplings, shrubs, graminoids, and forbs, and may not necessarily total 100%. Ground cover measurements include percent cover of plant basal area (including cacti), boles, litter, bare soil, rock, and gravel, and must total 100%.



Data processing and reporting

At this time, we use FFI software, as well as Excel spreadsheets, to enter and analyze our data. FFI is able to export to FVS and FuelCalc. FFI software and User Guides are available for download here: https://www.frames.gov/partner-sites/ffi/software-and-manuals/

In order to process individual piñons, junipers and oaks with more than 2 stems or whose branch structure made access difficult and were therefore measured at root collar (DRC) instead of breast height (DBH), we use the equations developed by Chojnacky and Roger (1999).

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

Sample reports can be found on our website: http://nmfwri.org/resources/restoration-information/cfrp/cfrp-long-term-monitoring/cfrp-long-term-monitoring

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

2017 New Mexico Forest and Watershed Restoration Institute Monitoring Team:

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

2017 New Mexico Forest and Watershed Restoration Institute GIS Team:

- Patti Dappen, GIS Specialist

Other persons contacted:

- Shirley Piqosa, Forester, Pueblo of Acoma
- Fred Rossbach, Field Coordinator, Greater Rio Grande Watershed Alliance

Pueblo of Acoma Horace Mesa PJ Project (16-15) Description

Project 16-15 is located on the Pueblo of Acoma in Cibola County, northeast of Grants, NM.

The average annual precipitation in the nearby city of Grants, NM is 10.5 inches. The average high temperature is 91° F in July, and the average low is 15° F in December and January.[12] NRCS Web Soil Survey soils information is not available at this time of this report for this project area.[13]

Monitoring was conducted at this 55.5-acre site on June 27, 2017 as a forest and watershed health treatment to reduce the tree cover in a piñon-juniper savanna/woodland. The project is located on the Pueblo of Acoma approximately 6 miles northeast of the city of Grants in Cibola County, NM. The project area is known as Horace Mesa and is immediately adjacent to the Cibola National Forest. It is accessed off Forest Road 193. The Lava Soil and Water Conservation District (LSWCD) sponsored the project. The project is a forest health treatment to create a more open forest structure, reduce fire hazard, and restore the area vegetation to historic conditions including a meadow. The project will consist of heavy thinning to a residual 20 square feet per acre of basal area in the woodland; material over 3 inches will be salvaged for firewood. Project treatments will follow the GRGWA 2016 Piñon-Juniper Prescriptions, in Appendix III – Planned Treatment Prescription.

[12] (U.S. Climate Data, 2017)
[13] (USDA NRCS, 2013)

GRGWA 16.15 Horace Mesa Acoma Pueblo - Overview Map

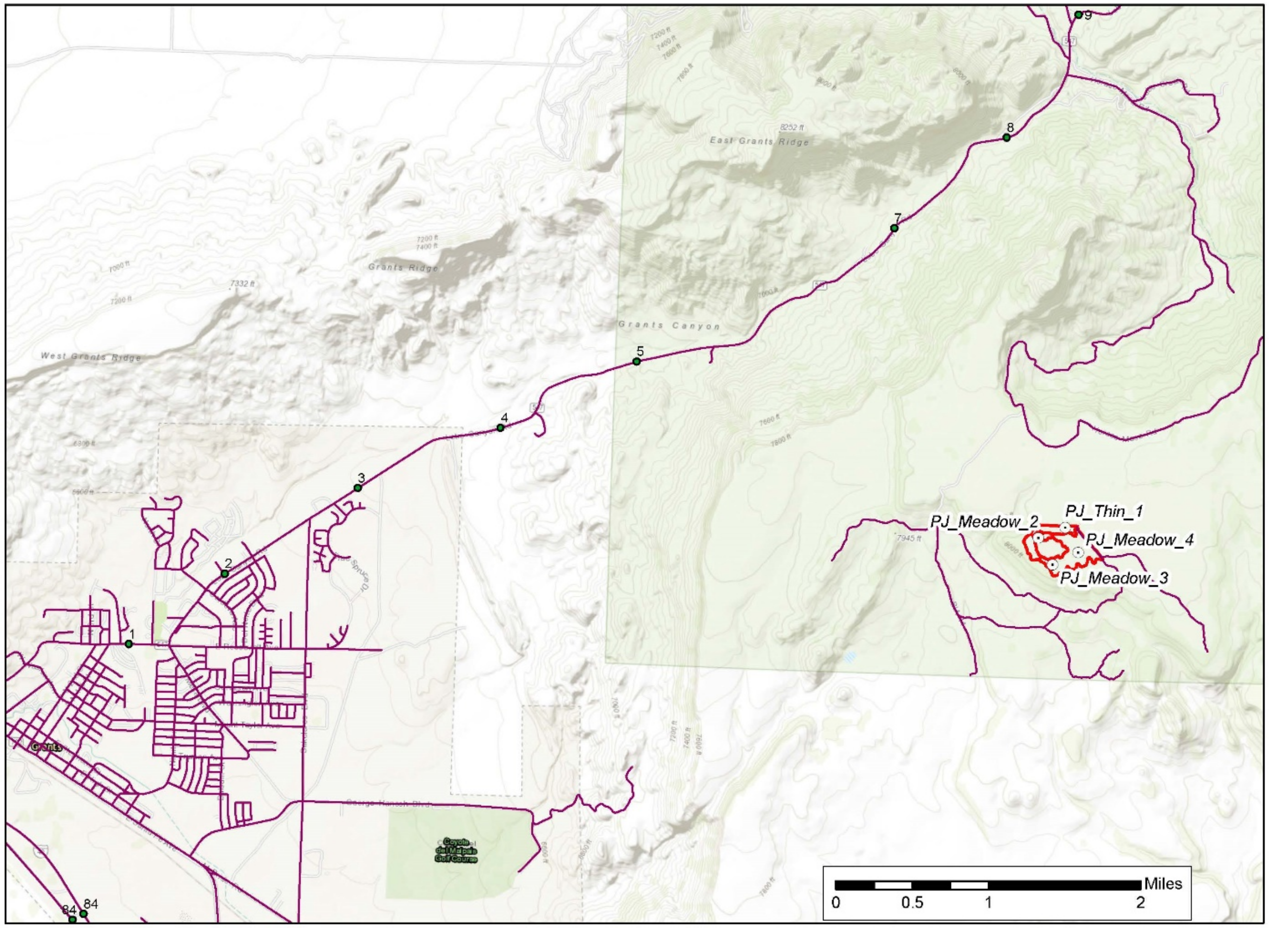


Figure 2. Grants (left) and project 16-15.

The LVSWCD/Pueblo of Acoma GRGWA site 16-15 is located off Forest Road 193 at around 8000 feet. Dominant natives observed at the time of the site visit included snakeweed, rubber rabbitbrush, pricklypear, budsage, piñon, and oneseed juniper. Native grasses and forbs including penstemon and Indian paintbrush flowers were also noted. Mistletoe was observed in the oneseed juniper. Nonnative species did not appear dominant.

Monitoring Results

We randomly placed 4 plots on slopes ranging from 1% to 3%, with an average of 2%. Aspect on plots was distributed 25% East, 25% South, and 50% West. Of these plots, 1 was in the Forestland area ("PJ Thin1") and 3 were in the Meadow (1 in "PJ Meadow1," and 2 plots in "PJ Meadow2").

GRGWA 16.15 Horace Mesa Acoma Pueblo - 2016 OrthoImagery

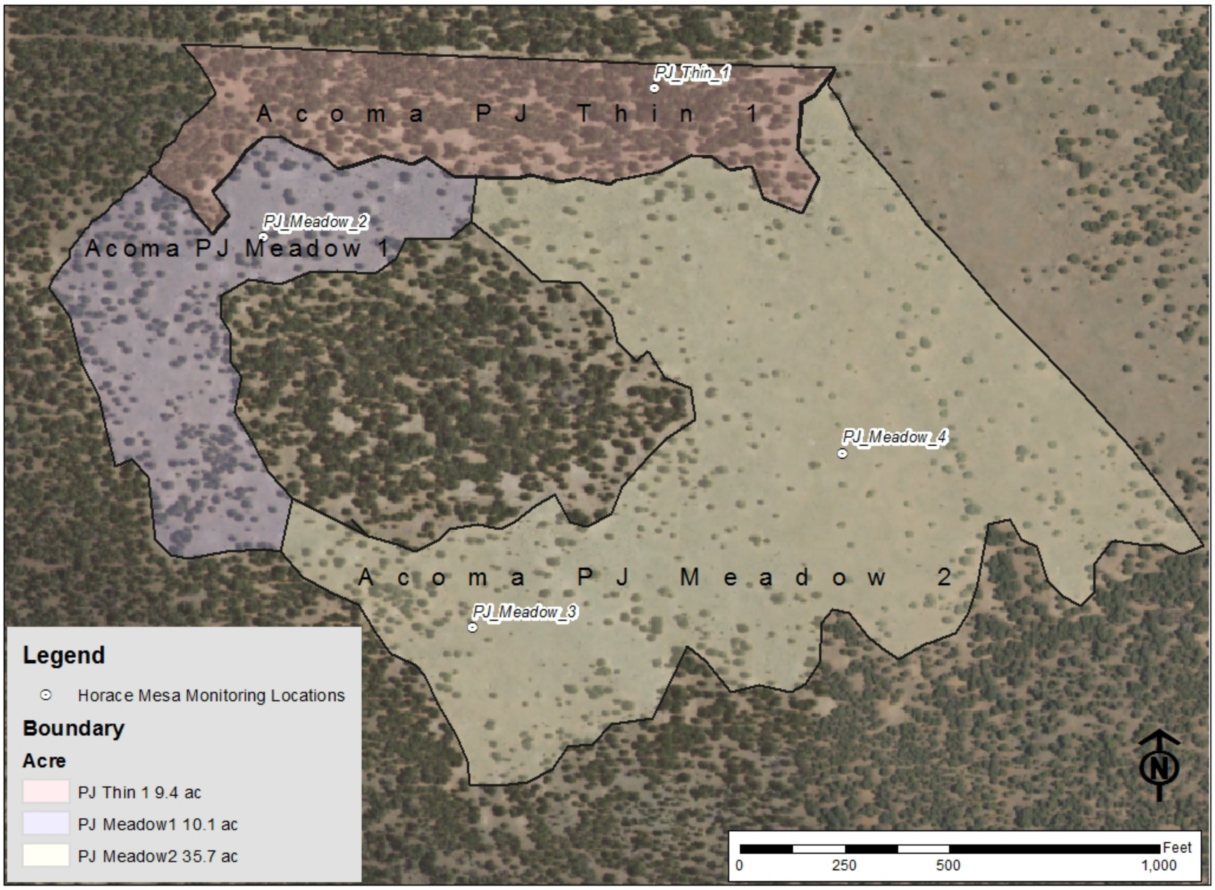


Figure 3. 16-15 Horace Mesa monitoring plot locations.

Tree Component

Among the meadow plots, the average number of trees per acre (TPA) was 20; on the forest plot 180 TPA was recorded (Figure 4). The average basal area of the meadow plots was 6.6 ft^2/acre, and for the forest it was 106 ft^2/acre (Figure 5). Meadow tree heights averaged 9.7 feet, live crown base height averaged 0.2 feet, and the quadratic mean diameter (QMD) was 7.8 inches. The forest plot had an average tree height of 18 feet, with a live crown base height of 4.3 feet, and a QMD of 10.4 (Figure 6). In the meadow the trees were 34% oneseed juniper (6.7 TPA) and 66% piñon (13 TPA). In the forest, the plot had 11% oneseed juniper (20 TPA) and 89% piñon (160 TPA) (Figure 7). Average height, QMD, and live crown base height (LiCrBHt) are displayed by species in Table 1, below.

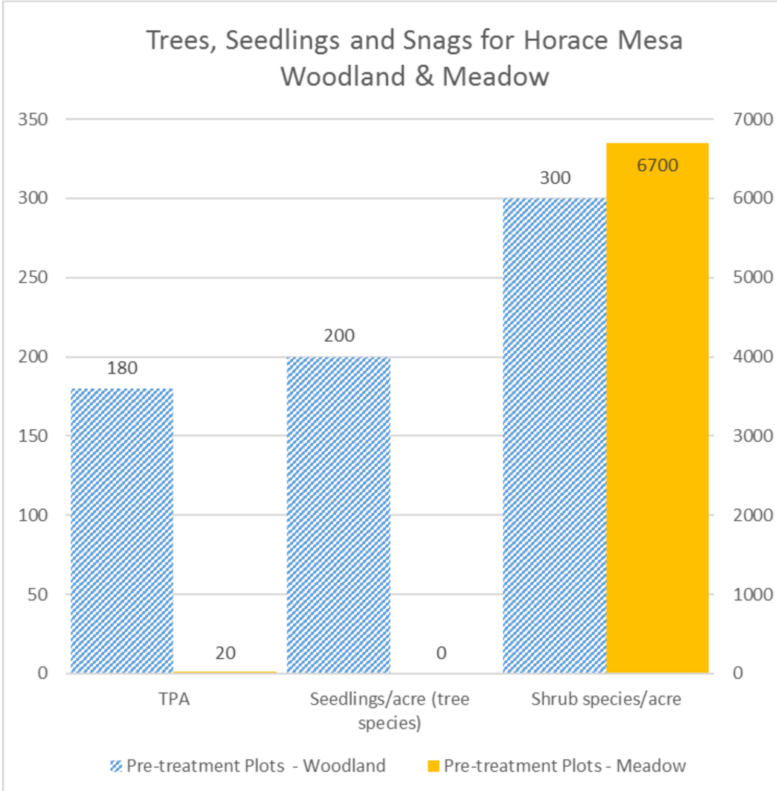


Figure 4. Trees, Seedlings, and shrubs per acre for 16-15.

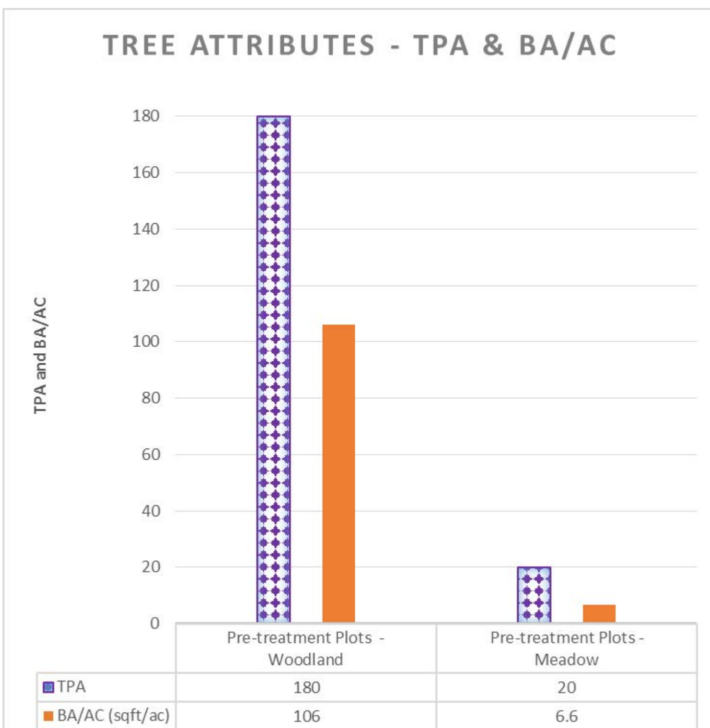


Figure 5. Trees per acre and basal area (in square feet per acre) for 16-15.

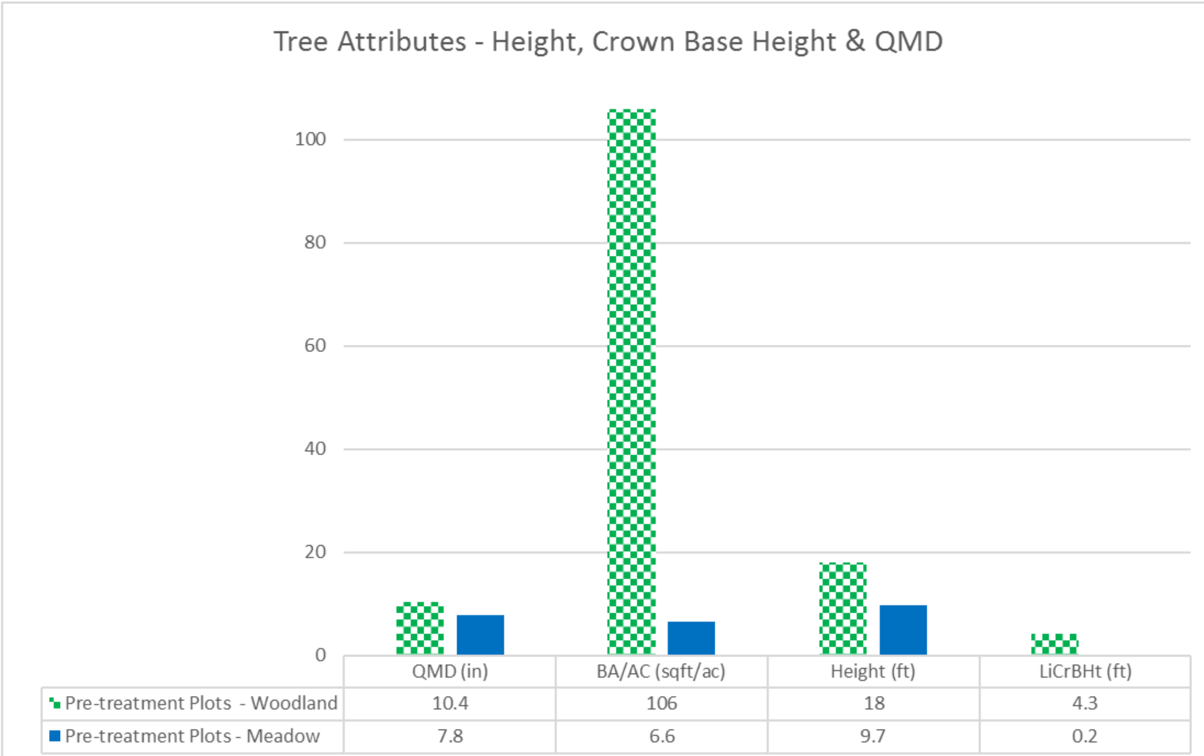


Figure 6. Height, Crown Base, Basal Area and QMD for 16-15.

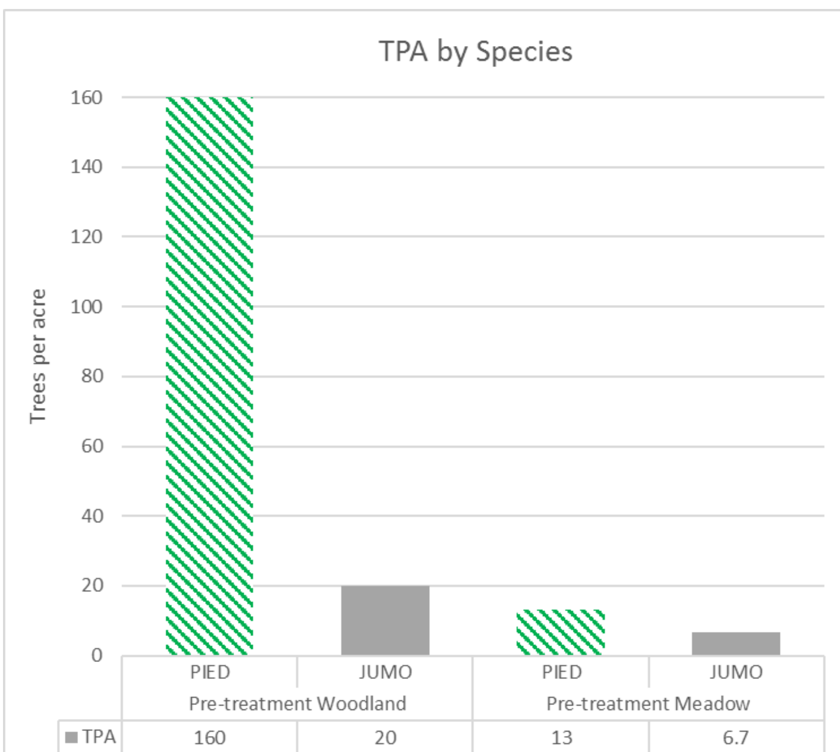


Figure 7. Trees per acre by species for 16-15.

Table 1. Average height, QMD and LiCrBHt of 16-15.

Type	Species	QMD (in)	Avg Ht (ft)	Avg LiCrBHt (ft)
Pre-treatment Woodland (1 plot)	Piñon	10.4	19	4.6
	Oneseed juniper	10.5	10	1.5
Pre-treatment Meadow (3 plots)	Piñon	5.8	11	0.5
	Oneseed juniper	8.8	7	0

Number of stems was also recorded for each tree. It was common for juniper species to have multiple stems in both meadow and forest. Two meadow trees had 8 stems or more.

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 piñon on the forest plot; sick trees were both piñon and oneseed juniper in the meadow.

No snags were recorded on any of these plots.

The meadow plots had no tree seedlings. On the forest plot, 200 seedlings per acre were recorded, and of these, 100% were piñon.

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 8.

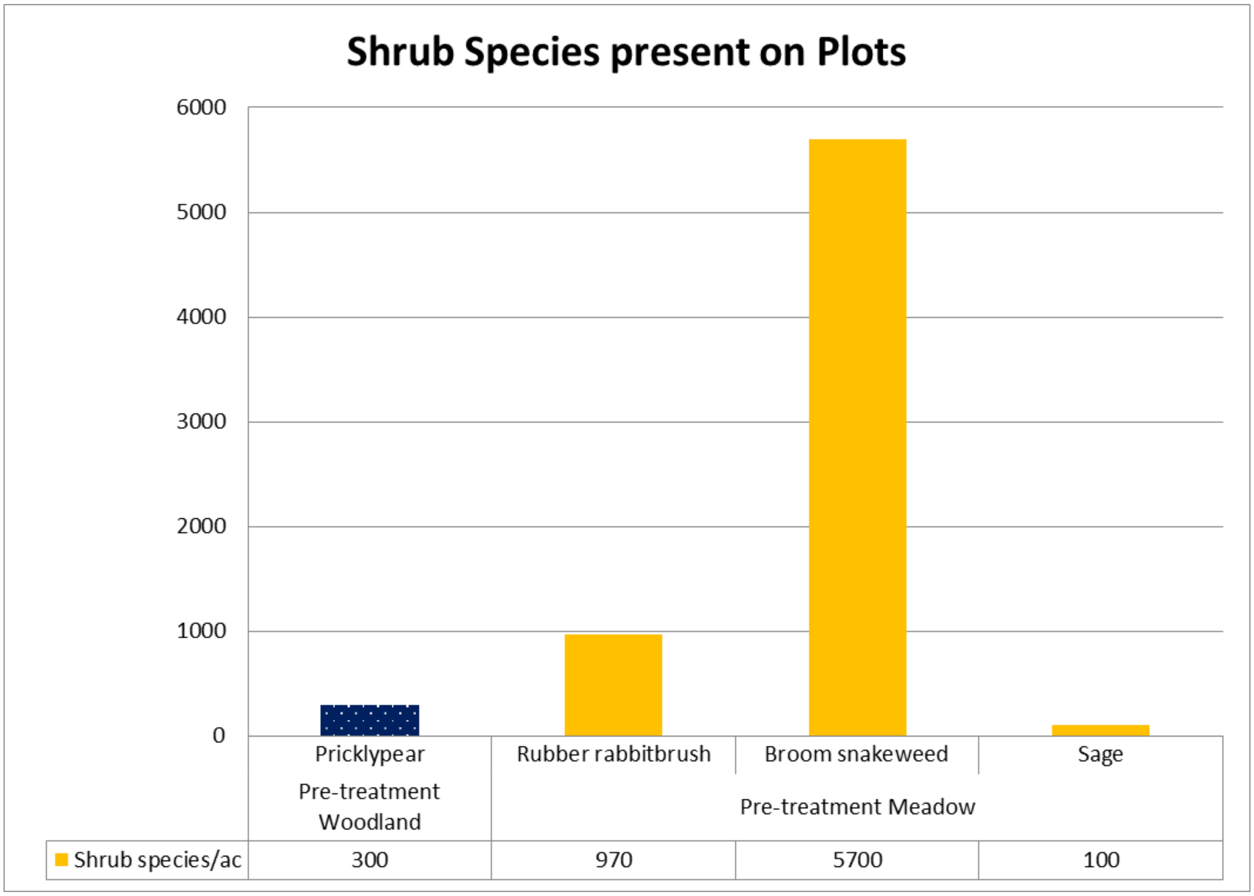


Figure 8. Shrubs per acre by species for 16-15.

Stand tables and plot summaries for all plots can be found in Table 2 through Table 5 below.

Table 2. Summary table for all plots.

16-15 Horace Mesa Meadow Pre-tx			2017		
Summary Table for all Plots			**# Sample Trees on plot**	**Trees per acre**	**Basal area per acre**
Plot Total			**6.00**	**20.00**	**6.60**
Growing Stock		Healthy (H)	0.00	0.00	0.00
		Unhealthy(U)	0.00	0.00	0.00
		Sick (S)	2.00	6.67	2.76
		Living (L)	4.00	13.33	3.83
Sum of Growing Stock			**6.00**	**20.00**	**6.60**
Dead		Dead (D)	0.00	0.00	0.00
Sum of Dead			**0.00**	**0.00**	**0.00**
Plot Total: Growing Stock & Dead		**Sum of**	**6.00**	**20.00**	**6.60**

16-15 Horace Mesa Forestland Pre-tx			2017		
Summary Table for all Plots			**# Sample Trees on plot**	**Trees per acre**	**Basal area per acre**
Plot Total			**18.00**	**180.00**	**106.34**
Growing Stock		Healthy (H)	0.00	0.00	0.00
		Unhealthy(U)	0.00	0.00	0.00
		Sick (S)	3.00	30.00	6.07
		Living (L)	15.00	150.00	100.27
Sum of Growing Stock			**18.00**	**180.00**	**106.34**
Dead		Dead (D)	0.00	0.00	0.00
Sum of Dead			**0.00**	**0.00**	**0.00**
Plot Total: Growing Stock & Dead		**Sum of**	**18.00**	**180.00**	**106.34**

Table 3. Individual plot summaries for all plots.

16-15 Horace Mesa Meadow Pre-tx				
Individual Plot Summary Table				
Macro Plot Name	Total number of sample trees on plot	Growing Stock		
		Number of growing stock sample trees on plot	Trees per Acre	Basal Area per Acre
AHM Meadow 2	3	3	30	10.76
AHM Meadow 3	3	3	30	9.03
AHM Meadow 4	0	0	0	0.00
Total	**Total number of sample trees on plot**	**Number of growing stock sample trees on plot**	**Average for all Plots**	
			TPA	**BA/AC**
	6.00	**6.00**	**20.00**	**6.60**

16-15 Horace Mesa Forested Pre-tx				
Individual Plot Summary Table				
Macro Plot Name	Total number of sample trees on plot	Growing Stock		
		Number of growing stock sample trees on plot	Trees per Acre	Basal Area per Acre
AHM_PJ_1	18	18	180	106.34
Total	**Total number of sample trees on plot**	**Number of growing stock sample trees on plot**	**Average for all Plots**	
			TPA	**BA/AC**
	18.00	**18.00**	**180.00**	**106.34**

Table 4. Woodland species stand table for Horace Mesa Forest plot.

Stand Table		16-15 Horace Mesa Forested Pre-tx																		
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	0	1	2	2	3	2	4	0	1	0	1	0	0	0	0	0	0	*16.00*	
Pinon pine	TPA	0.00	10.00	20.00	20.00	30.00	20.00	40.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	*160.00*	*88.89%*
	BA/AC	0.00	0.20	2.46	3.76	8.99	10.63	30.73	0.00	14.78	0.00	22.74	0.00	0.00	0.00	0.00	0.00	0.00	*94.28*	*88.66%*
	AVE HT. (HL)	0.00	9	18	15	22	22	21	0.00	21	0.00	20	0.00	0.00	0.00	0.00	0.00	0.00		
JUMO	COUNT	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	*2.00*	
One-seed juniper	TPA	0.00	10.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*20.00*	*11.11%*
	BA/AC	0.00	0.45	0.00	0.00	0.00	0.00	0.00	11.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*12.06*	*11.34%*
	AVE HT. (HL)	0.00	8	0.00	0.00	0.00	0.00	0.00	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Woodland Species Sub-total	*COUNT*	*0*	*2*	*2*	*2*	*3*	*2*	*4*	*1*	*1*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*18.00*	
	TPA	*0.00*	*20.00*	*20.00*	*20.00*	*30.00*	*20.00*	*40.00*	*10.00*	*10.00*	*0.00*	*10.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*180.00*	*100.00%*
	BA/AC	*0.00*	*0.64*	*2.46*	*3.76*	*8.99*	*10.63*	*30.73*	*11.61*	*14.78*	*0.00*	*22.74*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*106.34*	*100.00%*
	AVE HT. (HL)	*0.00*	*8*	*18*	*15*	*22*	*22*	*21*	*12*	*21*	*0.00*	*20*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*		
Summary by Size Class for Woodland Species	*TPA*	*40.00*			*70.00*			*70.00*											*180.00*	
	TPA %	*22.22%*			*38.89%*			*38.89%*											*100.00%*	
	BA/AC	*3.10*			*23.38*			*79.86*											*106.34*	
	BA/AC %	*2.92%*			*21.98%*			*75.10%*											*100.00%*	
	QUADRATIC MEAN DIA.	*3.77*			*7.83*			*14.46*											*10.41*	
	AVE HT. (HL)	*16*			*21*			*19*											*20*	

Table 5.Woodland species stand table for 3 Horace Mesa Meadow plots.

Stand Table		16-15 Horace Mesa Meadow Pre-tx																		
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	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	*4.00*	
Pinon pine	TPA	0.00	0.00	3.33	3.33	3.33	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*13.33*	*66.67%*
	BA/AC	0.00	0.00	0.21	0.88	1.23	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*3.80*	*57.57%*
	AVE HT. (HL)	0.00	0.00	11	8	12	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
JUMO	COUNT	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	*2.00*	
One-seed juniper	TPA	0.00	0.00	0.00	0.00	3.33	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*6.67*	*33.33%*
	BA/AC	0.00	0.00	0.00	0.00	1.27	1.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*2.80*	*42.43%*
	AVE HT. (HL)	0.00	0.00	0.00	0.00	7	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Woodland Species Sub-total	*COUNT*	*0*	*0*	*1*	*1*	*2*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*6.00*	
	TPA	*0.00*	*0.00*	*3.33*	*3.33*	*6.67*	*6.67*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*20.00*	*100.00%*
	BA/AC	*0.00*	*0.00*	*0.21*	*0.88*	*2.51*	*3.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*6.60*	*100.00%*
	AVE HT. (HL)	*0.00*	*0.00*	*11*	*8*	*9*	*10*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*		
Summary by Size Class for Woodland Species	*TPA*	*3.33*			*16.67*			*0.00*											*20.00*	
	TPA %	*16.67%*			*83.33%*			*0.00%*											*100.00%*	
	BA/AC	*0.21*			*6.39*			*0.00*											*6.60*	
	BA/AC %	*3.19%*			*96.81%*			*0.00%*											*100.00%*	
	QUADRATIC MEAN DIA.	*3.40*			*8.38*			*0.00*											*7.78*	
	AVE HT. (HL)	*11*			*9*			*0.00*											*10*	

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.

Cover values for the forest plot were as follows: 85% tree canopy cover, 2% seedling/sapling cover, 1% shrub cover, 31% graminoid and forb cover, 22% cover by plant basal and bole, 56% litter cover, 2% rock and gravel cover, and 20% bare soil. See Table 6.

Table 6. Tree canopy, understory and ground cover for 16-15.

Horace Mesa Forest 2017	**Aerial cover**			
Tree Canopy	**Seedlings/Saplings**	**Shrub cover**	**Graminoid Cover**	**Forb Cover**
85%	2%	1%	30%	1%

Horace Mesa 2017 Ground cover					
Plant Basal	**Bole**	**Litter**	**Bare Soil**	**Rock**	**Gravel**
20%	2%	56%	20%	0%	2%

Average cover values for the Meadow plots were as follows: 0% tree canopy cover, 0% seedling/sapling cover, 25% shrub cover, 62% graminoid and forb cover, 62% cover by plant basal and bole, 7% litter cover, 2% rock and gravel cover, and 30% bare soil. See Table 6. Cover values varied by relatively little by individual plot.

Table 7. Tree canopy, understory and ground cover for 16-15.

Horace Mesa Meadow 2017	**Aerial cover**			
Tree Canopy	**Seedlings/Saplings**	**Shrub cover**	**Graminoid Cover**	**Forb Cover**
0%	0%	25%	50%	12%

Horace Mesa 2017 Ground cover					
Plant Basal	**Bole**	**Litter**	**Bare Soil**	**Rock**	**Gravel**
45%	17%	7%	30%	1%	1%

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). See Table 8, below.

Table 8. Planar intercept cover and fuels for 16-15.

Horace Mesa Forest Plot				
Fuel	**Avg Cover %**	**Avg Ht (ft)**	**Avg Biomass (tons/ac)**	**Total biomass (tons)**
HD	16.5	0.0	0.02	0.02
HL	6.5	0.5	0.08	0.08
SD	0.0			
SL	1.5	3.5	0.25	0.25
TOTAL (AVG)	6.1	1.35	0.12	*SUM = 0.12*

Horace Mesa Meadow Plots				
Fuel	**Avg Cover %**	**Avg Ht (ft)**	**Avg Biomass (tons/ac)**	**Total biomass (tons)**
HD	3.6	0	0	0.02
HL	7.3	0.3	0.1	0.25
SD	0			0.0
SL	0.5	1.0	0.1	0.07
TOTAL (AVG)	2.9	0.43	0.07	*SUM = 0.34*

Surface fuels were measured at all plots using Brown's transects. For results, see Table 9.

Table 9. Surface fuels for all plots.

Horace Mesa Forest 2017	
Fuel	**Avg Tons/Ac**
1-Hour	0.19
10-Hour	2.7
100-Hour	0.83
1000-Hour	5.4
Duff	30
Litter	6.2
TOTAL FINE WOOD FUELS	3.8
TOTAL WOOD FUELS	9.2
TOTAL SURFACE FUELS	45
Fuel	**Depth (inches)**
Duff	3.0
Litter	1.3
TOTAL DEPTH	4.3

Horace Mesa Meadow 2017	
Fuel	**Avg Tons/Ac**
1-Hour	0
10-Hour	0
100-Hour	0
1000-Hour	0.0
Duff	2.9
Litter	0.0
TOTAL FINE WOOD FUELS	0
TOTAL WOOD FUELS	0
TOTAL SURFACE FUELS	2.9
Fuel	**Depth (inches)**
Duff	0.29
Litter	0
TOTAL DEPTH	0.29

Decay classes of logs (1000-hour fuels) were also recorded. There were no logs recorded on the meadow plots. Both logs found on the forest plot were decay class 3. Both snags and logs provide wildlife habitat and are an important part of a restored landscape.

Summary

The following table outlines a summary of 2017 pretreatment conditions for this site.

Table 10. Data summary for all 16-15 plots.

Metric	Forest Average (if applicable)	Meadow Average (if applicable)	Range of values on meadow plots (if applicable)
Trees per acre	180	20	0 - 30
Dominant tree (numerically)	piñon	piñon	---
Basal area (ft^2/acre)	106	6.6	0-11
QMD (inches)	10.4	7.8	3.4 – 9.2 (DBH on individual trees)
Average tree height (ft)	18	9.7	8.3-11 (per plot average)
Height of tallest tree (ft)	25	13	----
Average LiCrBHt (ft)	4.3	0.2	0-0.3 (per plot average)
Seedlings per acre	200	0	0
Dominant seedling (numerically)	piñon	---	----
Saplings per acre	0	0	0
Dominant sapling (numerically)	---	---	-----
Shrubs per acre	300	6700	3000 - 8800
Dominant shrub (numerically)	pricklypear cactus	Broom snakeweed	----
Sick trees per acre	30	6.7	0 - 10
Dominant sick tree (numerically)	piñon	piñon/oneseed juniper	----
Snags per acre	0	0	0
Dominant snag (numerically)	---	---	----
Average slope (%)	1	2%	1 – 3%
Dominant aspect	west	---	east, west, south
Canopy cover (%)	85%	0%	0%
Grass and forb cover (%)	31%	62%	50 – 70%
Bare, rock & gravel cover (%)	22%	32%	30 – 35%
Average total tons of surface fuel per acre	45	2.9	2.5 – 3.7

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.

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Appendix I – Plot coordinates

Horace Mesa Plot Center Coordinates		
ID	Lat	Long
AHM_1_Forest	35.1747	-107.73079
AHM_2_Meadow	35.17369	-107.73389
AHM_3_Meadow	35.1712	-107.73211
AHM_4_Meadow	35.17241	-107.72926

Appendix II – Selected Photos

AHM_16.15_1_Forest_N, taken looking north from plot center.

AHM_16.15_1_Forest_W, taken looking west from plot center.

AHM_16.15_2_Meadow_E, taken facing east from plot center.

AHM_16.15_3_Meadow_C, taken facing south toward plot center from 75 feet north.

AHM_16.15_4_Meadow_S, taken facing south from plot center.

Appendix III – Planned Treatment Prescription

GRGWA, 2016 General Pinon-Juniper Prescriptions.

Provided by Fred Rossbach

General Project Management

- Landowner/land manager will be responsible for clear identification of property lines and making personnel readily available for project implementation.
- Protect perimeter fences. Plan should address interior fences.
- Assume hand crew with chainsaw work only.

Prescriptions.

- In moderate density persistent pinon-juniper woodland along the property fence line: Create a open forest stand or shaded fuel break along the property fence line. Average basal area of residual stand should be approximately 20 sq. feet per acre.
- In heavy density, persistent pinon-juniper woodland: Conduct a heavy thinning to reduce stand density to a basal area of 40 square feet per acre or less. Treat pinon pine, and juniper tree species. Tree distribution of residual stand should be clumpy/groupy. Leave a variety of species and size classes in irregularly spaced and shaped, 5 to 20 tree, groups or clumps.
- In pinon-juniper meadow area: Restore moderate to light density, pinon-juniper meadow area by removing most of the trees. Leave one to several single trees for habitat and grazing shade. Select trees that are large, full-crowned and healthy. Leave an average basal area of 10 square feet per acre or less.
- Do not cut any Ponderosa pine, Douglas fir, or oak that may be present. Leave these species for stand diversity.
- No pruning will be required except for safety reason. Avoid pruning trees for vehicle access. Take the whole tree down if needed.
- Retain 5 to 7 snags (standing dead trees). Leave all snags of at least 14 inches in diameter. Roost trees or trees with cavities should be retained where possible. Roost trees are defined as a perch on which domestic fowl or other birds rest or sleep and a place with perches for fowl or other birds.
- Treat existing down trees, logs, etc. Retain one to five logs per acre with a diameter of 12 inches or larger, 8 feet or longer and in various states of decay will be left for down woody log retention and wildlife habitat. These requirements have been difficult to meet for this and other projects, but down logs and snags are rare in this timber type. Care should be used to leave what down logs are available untouched on the site.

Slash treatment by the lop and scatter method

- Stumps heights shall be less than ½ the diameter (at root collar, DRC) and never greater than 6 inches.
- Utilize woody material greater than 3 inches in diameter as firewood. Firewood should be piled on the project area. Piles shall be no larger than ½ cord in size and placed away from residual trees or fence lines.
- Remaining woody material is considered slash and must be treated to below an 18 inch height by the lop and scatter method.
- No hang ups or partially treated trees.

Best Management Practices/Erosion Control

- Juniper slash may be placed in areas with signs of sheet, rill or gully erosion and areas of soil **pedalisting** (severe hummocking). Place slash with tops pointing up slope. Slash in drainages shall be on greater than 1/3 the height of the top of bank.
- Leave at least 50 foot Steam-side Management Zone (buffer) alongside all intermittent streams (as defined by a USGS 1:24,000 topographic map)
- Hand constructed water bars on project roads. Where the grade is from 0.0 to 5% at intervals of 150 feet, where the grade is from 5% to 10% at intervals of 130 feet, where the grade is from 10% to 15% at intervals of 75 feet and where the grade is from 15% to 40% at intervals of 50 feet.
- Minimize vehicle traffic in the meadow areas on the project. Minimal will be defined as once only for treatment purposes. Limit use of roads to old roads identified and avoid creating new roads of any kind.