Pueblo of Sandia Project 21.02 & 21.03

Post Treatment Monitoring Report

Prepared by

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for the ***Greater Rio Grande Watershed Alliance***

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Acronyms and Abbreviations

Table 1. Acronyms and abbreviations used in this report.

Acronym, Abbreviation, or Term	Explanation or Definition as used by NMFWRI
BEMP	Bosque Ecosystem Monitoring Program, small rectangular plot types
CSE	Common Stand Exam
CSWCD	Coronado Soil and Conservation District
GIS	Geographic Information Systems
GRGWA	Greater Rio Grande Watershed Alliance
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
QMD	Quadratic Mean Diameter
PC	Plot center
SWCD	Soil and Water Conservation District
TPA	Trees Per Acre
USDA	United States Department of Agriculture

Purpose of Report

This report covers the low- and high-intensity pre-treatment vegetation monitoring assessments performed on the 21.02 and 21.03 non-native vegetation removal projects submitted for the Pueblo of Sandia to the Greater Rio Grande Watershed Alliance in 2017. Following a discussion of the ecological context, and our monitoring methods, we present pertinent background, observations, and assessment results for the projects.

Ecological Context of Bosque Restoration

Neither the challenges nor the importance of working in the bosque and other riparian areas in New Mexico today should be underestimated. According to the New Mexico Department of Game and Fish Conservation Division, wetlands and riparian areas comprise approximately 0.6 percent of all land in New Mexico (2012). Despite this small percentage, estimates of New Mexican vertebrate species depending on wetland and riparian habitat for their survival range from 55% (New Mexico Department of Game and Fish Conservation Services Division, 2012) to 80% (Audubon New Mexico, 2013). These areas also provide flood mitigation, filtration of sediment and pollutants, and water for a variety of purposes including groundwater recharge (Audubon New Mexico, 2013). In addition, native vegetation such as cottonwoods have cultural significance to many communities.

As much as these areas are disproportionately important to ecosystems and human communities, they are equally disproportionately impacted by disturbance. Anthropogenic impacts with major consequences for our riparian areas include dams, reservoirs, levees, channelization, acequias and ditches, jetty jacks, riprap and Gabion baskets, urbanization, removal of native phreatophytes, grazing by domestic livestock, excessive grazing pressure by native ungulate populations absent natural predation cycles, beaver removal, logging, mining, recreation, transportation, introduction and spread of invasive exotic species, groundwater extraction, altered fire and flood regimes drought and climate change (Committee on Riparian Zone Functioning and Strategies for Management, et al., 2002). Statewide, it is estimated that as much as 90% of New Mexico’s historical riparian areas have been lost (Audubon New Mexico, 2013), and approximately 39% of our remaining perennial stream miles are impaired (New Mexico Department of Game and Fish Conservation Services Division, 2012).

New Mexico is fortunate enough to have the Middle Rio Grande Bosque, the largest remaining bosque in the Southwest (USDA USFS, 1996). However, over the past two decades, the number of fires in the bosque has been increasing. Historically, the primary disturbance regime in the bosque has been flooding, not fire, which means the system is not fire-adapted. In fact, native species like cottonwood resprout from their roots after floods and need wet soils to germinate from seed. Flooding also promotes decomposition of organic material and keeps the soil moist, which reduces the likelihood of fire. Today, overbank flow is uncommon in many areas of the Rio Grande due to the heavy alteration of the channel and flow regimes (two obvious examples are the structures defining the upper and lower extent of the Middle Rio Grande: Cochiti Dam and Elephant Butte Reservoir). This has led to low fuel moisture content and high fuel loads, as well as increased human presence in the riparian area. As a result, bosque fires are more common and more severe: they kill cottonwoods and other native species, creating spaces which are filled by non-native species such as salt cedar, Russian olive, Siberian elm, and Tree-of-Heaven. We are constantly learning more about how these species can exploit and encourage a riparian fire regime, in addition to many other changes they bring to ecosystems.

Efforts geared toward the removal of these nonnative species can help to reduce fire risk, preserve native vegetation, and be part of a larger effort to restore the bosque and the watershed as a whole to a more natural and functional ecosystem. The Greater Rio Grande Watershed Alliance (GRGWA) has been working on these issues with a variety of collaborating organizations and agencies within the Rio Grande basin for several years. 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 projects as well as to perform the formal pre- and post-treatment monitoring, utilizing the field methods explained below as well as LIDAR analysis where appropriate and available.

Monitoring and Field Methods

Low intensity Field Methods - Photopoints

Photopoints were established to capture images where vegetation shifts were observed and/or at representative locations throughout the site. Waypoints were marked with a GPS unit and named sequentially by site. Photos were taken facing north, east, south and west at each point. Information about the photopoints was collected according to the methods laid out in David Lightfoot's Forest Thinning Project Repeat Photo Points for Restoration Effectiveness Monitoring (David Lightfoot, 2014). Photopoints were collected both pre- and post-treatment.

High-intensity Field Methods – CSE Plots

For post-treatment monitoring, we added additional riparian-adapted Common Stand Exams (CSE). CSE plot locations are synonymous with pre-treatment photopoint locations where possible; in some cases, additional plots are established to reach the target sampling density. Once the plot location was determined a 1/100- and 1/10-acre radius plot was established by placing pin-flags at 11’ 9” and 37’ 3” from plot center in each cardinal direction. Photos were taken from plot center in each cardinal direction and from a distance of 75’ north of plot center toward plot center. Ocular estimates were made of understory aerial and ground cover within the 1/10-acre plot. Overstory canopy cover was estimated using a concave spherical densiometer, with measurements made in four cardinal directions, at the edge of the 1/100-acre plot. This method provides an estimate of canopy cover for a 1/10-acre area centered on the plot. A Hink & Ohmart and modified Hink & Ohmart structure class was determined for the 1/10th acre plot. Finally, all plant species observed within the 1/10^{th-}acre area with over 1% cover were recorded, as were other comments regarding conditions at the plot.

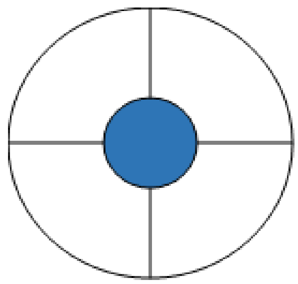

Figure 1 Example of CSE plot layout. The outer circle represents the 1/10-acre plot and the blue circle is the 1/100-acre plot.

Personnel Involved

2023 New Mexico Forest and Watershed Restoration Institute Monitoring & GIS Work:

- Kathryn R Mahan, Ecological Monitoring Specialist
- Ernesto Sandoval, Ecological Monitoring Technician
- Daniel Hernandez, Ecological Monitoring Technician

Other persons contacted:

- Fred Rossbach, Field Coordinator, Greater Rio Grande Watershed Alliance
- Michael Scialdone, Pueblo of Sandia Environment Department

2024 New Mexico Forest and Watershed Restoration Institute Monitoring & GIS Work

- Patrick Clay Goetsch, Riparian Crew Lead
- Emily Yannayon, Ecological Monitoring Specialist
- Abbi Han, Monitoring Technician
- Alex Withnall, Technician Assistant
- Taryn Schlosser, Technician Aide
- Michael Branch, Technician Aide
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Other persons contacted:

- Dierdre Tarr, District Manager for Claunch-Pinto SWCD, Greater Rio Grande Watershed Alliance
- Michael Scialdone, Pueblo of Sandia Environment Department

Pueblo of Sandia Project Context

The Pueblo of Sandia is a 39 square mile reservation north of Albuquerque and south of Bernalillo, New Mexico, at the base of the Sandia Mountains. The historical western boundary of the Pueblo is the Rio Grande. Today, the Pueblo is the steward of one of the largest remaining intact stretches of Rio Grande Bosque in the area. The bosque has a long history of ecological and cultural importance for the Pueblo, but in recent years it has been subject to the same stressors discussed above, especially drought, the impact of the 2011 Las Conchas fire, and fires on Pueblo lands (e.g. the 2012 Romero Fire). Human modifications to the river are easily observed on aerial maps – side channels; including the Albuquerque Main Canal, the Corrales Main Canal, the Albuquerque Riverside Drain, the Alameda Drain, the Bernalillo Interior Drain, the Atrisco Feeder Canal, and the Sandia Acequia, among others; intersect and diverge from the river throughout the western side of the Pueblo (MRGCD, n.d.).

Particularly in the past two decades, several bosque restoration efforts have been led by the Pueblo’s Environment Department in collaboration with agencies and organizations including the Bureau of Reclamation, the Middle Rio Grande Conservancy District, the US Army Corps of Engineers and the Greater Rio Grande Watershed Alliance.

This project was submitted in 2021, which was the fifth year the Pueblo of Sandia had collaborated on non-native phreatophyte removal projects with GRGWA. In 2013, project numbers 13-02, 13-03 and 13-04 worked on restoration after the Romero Fire; in 2014, project 14-01 worked at Sandia Lakes; projects 14-03 and 14-04 worked in the Bosquecito, projects 14-05 and 14-06 worked in the Sandia Wash area, and project 14-07 worked in the Riverside Drain. In 2015, projects 15-01 through 15-05 were distributed the length of the Pueblo; in 2016 projects 16-01 through 16-05 took place throughout the bosque. Projects 17-01 through 17-07 were submitted for 2017; many were re-treatments of previous projects in need of maintenance. In 2021 projects 21.02 and 21.03 were proposed as re-treatments of a 2013 project that was considered to have “escaped management” after a 2018 respray was observed ineffective.

The elevation at the Village of Sandia Pueblo is just over 5,000 feet. The area receives an average of 10 inches of rainfall per year, with temperatures ranging from an average high of 91 degrees Fahrenheit in July to an average low of 20 degrees Fahrenheit in January (City Stats, 2016). According to the NRCS Web Soil Survey, there are several soil map units in the area of the Pueblo of Sandia, but most soils are sand and clay loams; the dominant ecological sites are R042BE054NM Deep Sand Cool Desert Grassland, R042XA057NM Bottomland and R042XA055NM Salty Bottomland (USDA NRCS, 2013).

The Deep Sand, Cool Desert Grassland supports a grassland type community with large amounts of shrub cover. Climax plant community includes mixed grasses such as Giant Dropseed and Black Gramma. Forbs include Silverleaf Nightshade and globemallow. Ground cover is estimated to be 70%. Transition to increased woody and succulent plant presence occurs after ecosystem deterioration. In good growing conditions this site produces up to 900 pounds per acre of plant biomass (USDA NRCS n.d.).

The Bottomland ecological site is dominated by either giant sacaton or alkali sacaton. Vinemesquite grass and sideoats grama may also be present. Reduced cover and hummocking of these grasses characterize initial stages of degradation, typically due to overgrazing and/or changes in hydrology. Transitions to first tobosa- and then to burrograss-dominated states may occur in response to the redistribution of run-in water from overgrazing and subsequent erosion and gullying. Shrub invasion is not usually observed (USDA NRCS n.d.).

Salty Bottomland can support a range of plant communities which typically include cottonwood, salt cedar, mixed exotics (dominated by Russian olive/ Russian knapweed/ etc.), saltgrass and saltgrass-sacaton, and bottomland grassland (possibly dominated by saltgrass, giant sacaton, dropseed, muhly, burrograss, alkali sacaton, galleta, vinemesquite, and/or tobosa). Typically, the vegetation consists of a shrub/grass mixture characterized by fourwing saltbush and greasewood. Tall, mid-grass, and short grasses are present. Blue grama, foxtail, sand dropseed, spike dropseed, giant dropseed, New Mexico feathergrass and tansymustard are common. When the plant community deteriorates, there is an increase in densities of shrubs and short grasses (USDA NRCS n.d.)

Project 21.02 – Romero Fire

Pre-treatment monitoring was conducted on October 3rd, October 4th, and October 10th, 2023. Post-treatment monitoring was conducted on January 30th, February 4th, 6th, 11th, and 12th, and March 4th and 6th 2025. The project is located in the Pueblo of Sandia within Sandoval County, NM, north of the city of Albuquerque (Figure 2). It is on the east side of the Rio Grande near the Corrales Ditch and the Riverside Drain. The project was sponsored by the Coronado SWCD and the Pueblo of Sandia Environment Department Bosque Program. Treatment included cut stump herbicide and mastication of material of mostly Russian Olive re-sprouts, Salt Cedar and Siberian Elm. The stated restoration goals were to treat re-sprouts and create more open grassland following the Romero Fire and seeding. The project is 176.3 acres and contains ten monitoring plots, with 64 acres being treated. Pile burning was observed on the project site in 2025.

The project is a retreatment of non-native phreatophyte tree species primarily made up of Russian olive resprouts. Salt cedar, Siberian elm and Tree-of-heaven target trees will also be treated.

According to the NRCS Web Soil Survey, the project area is comprised of about 0.2% Trail loamy sand, 99.7% Peralta loam, moderately saline and 0.1% Peralta loam. This information is included only for reference, as the soil survey is not accurate at this scale, and the fact that the river moves should be considered. Ecological sites within this project include R042BE054NM – Deep Sand, Cool Desert, Grassland, R042BE057NM – Bottomland, Cool Desert Grassland and R042BE055NM – Salty Bottomland, Cool Desert grassland (USDA NRCS, 2023). See detailed descriptions of these landscape types above in the "Project Context" section.

This site was observed to have Russian Thistle (Salsola tragus), Russian Olive (Elaeagnus angustifolia), Alkali Sacaton (Sporobolus airoides) and Desert Salt Grass (Distichilis spicata). Other species with insignificant cover but noteworthy were Rushes (Juncus Spp.), Artemisia Spp. and Yerba Mansa (Anemopsis californica). It should be noted that this site was seeded in 2013 with Alkali Sacaton and Desert Salt grass.

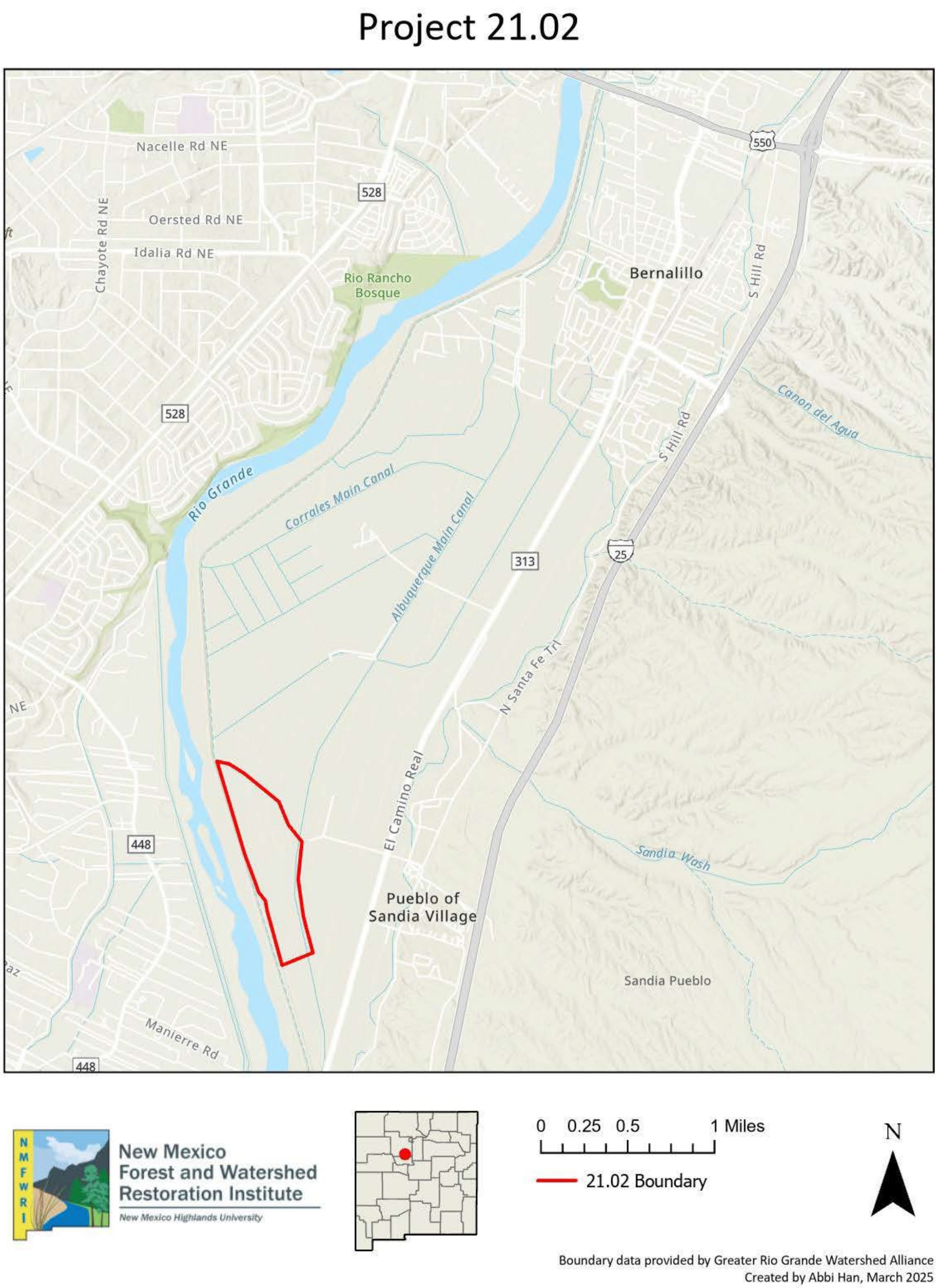


Figure 2. Region map of Project 21.02.

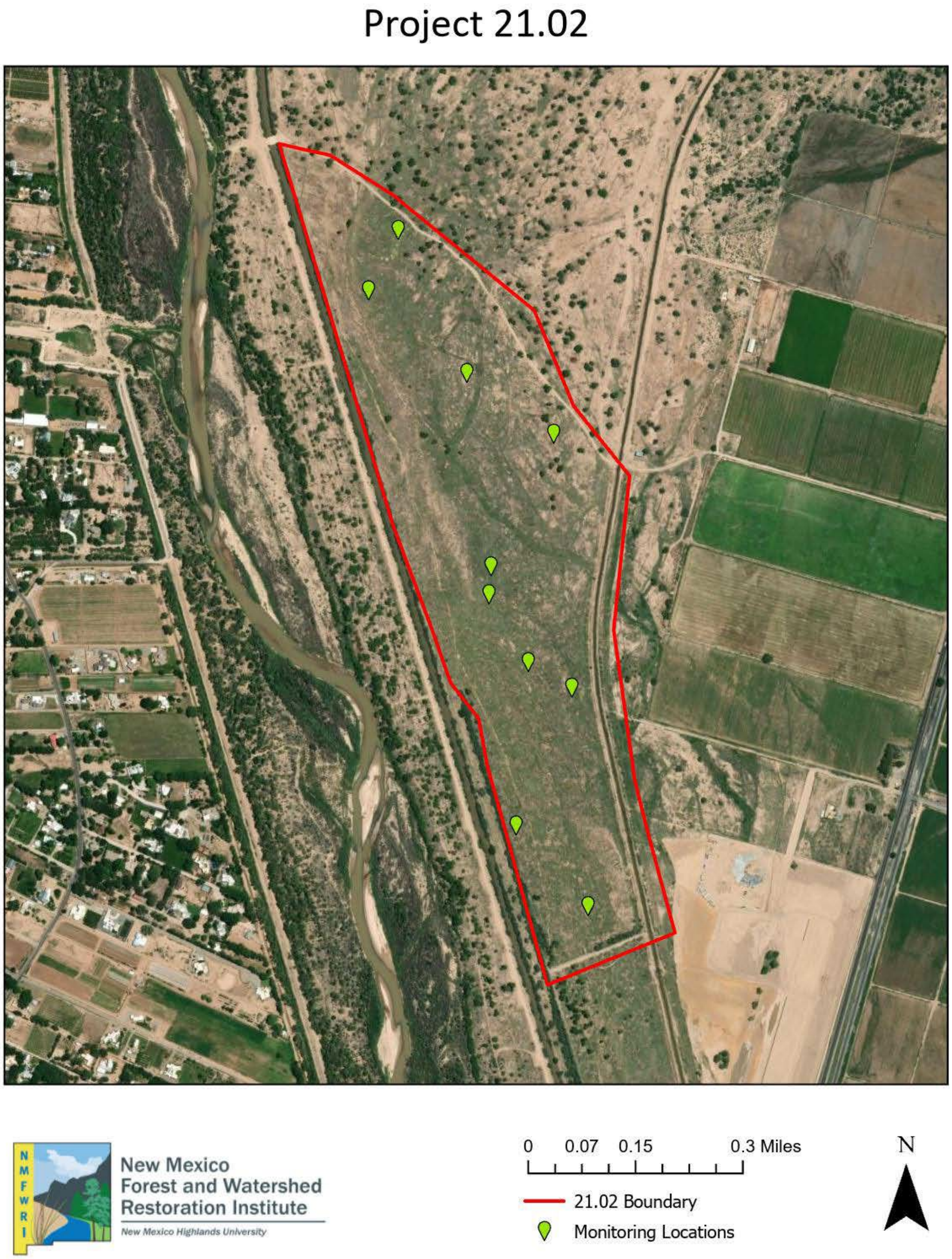


Figure 3. Plot locations for project 21.02.

Project 21.03 - Romero Fire

Monitoring was conducted at this project site on October 23rd, 2023. The project was sponsored by the Coronado SWCD and the Pueblo of Sandia Environment Department Bosque Program. Planned treatment includes cut stump herbicide and mastication of material of mostly Russian Olive resprouts, Salt Cedar and Siberian Elm, Mulberry will be left alone. Stated restoration goals are to treat resprouts and create more open grassland following the Romero Fire and Seeding restoration.

According to the NRCS Web Soil Survey, the project area is comprised of 100% Peralta Loam, moderately saline, sodic, 1 to 3 percent slopes. This information is included only for reference, as the soil survey is not accurate at this scale, and the fact that the river moves should be considered. Ecological sites within this project include R042BE055NM – Salty Bottomland, Cool Desert Grassland. See the "Project context" section above for a detailed description of this landscape type.

The site was observed to have Desert Saltgrass (D. spicata), Prickly Russian Thistle (S. tragus), Silver Nightshade (S. eleaegnifolium), Lycium spp., Alkali Sacaton (S. airoides) and Yerba Mansa (A californica). It should be noted that this site was seeded in 2013 with Alkali Sacaton and Desert Salt grass.

Project 21.03

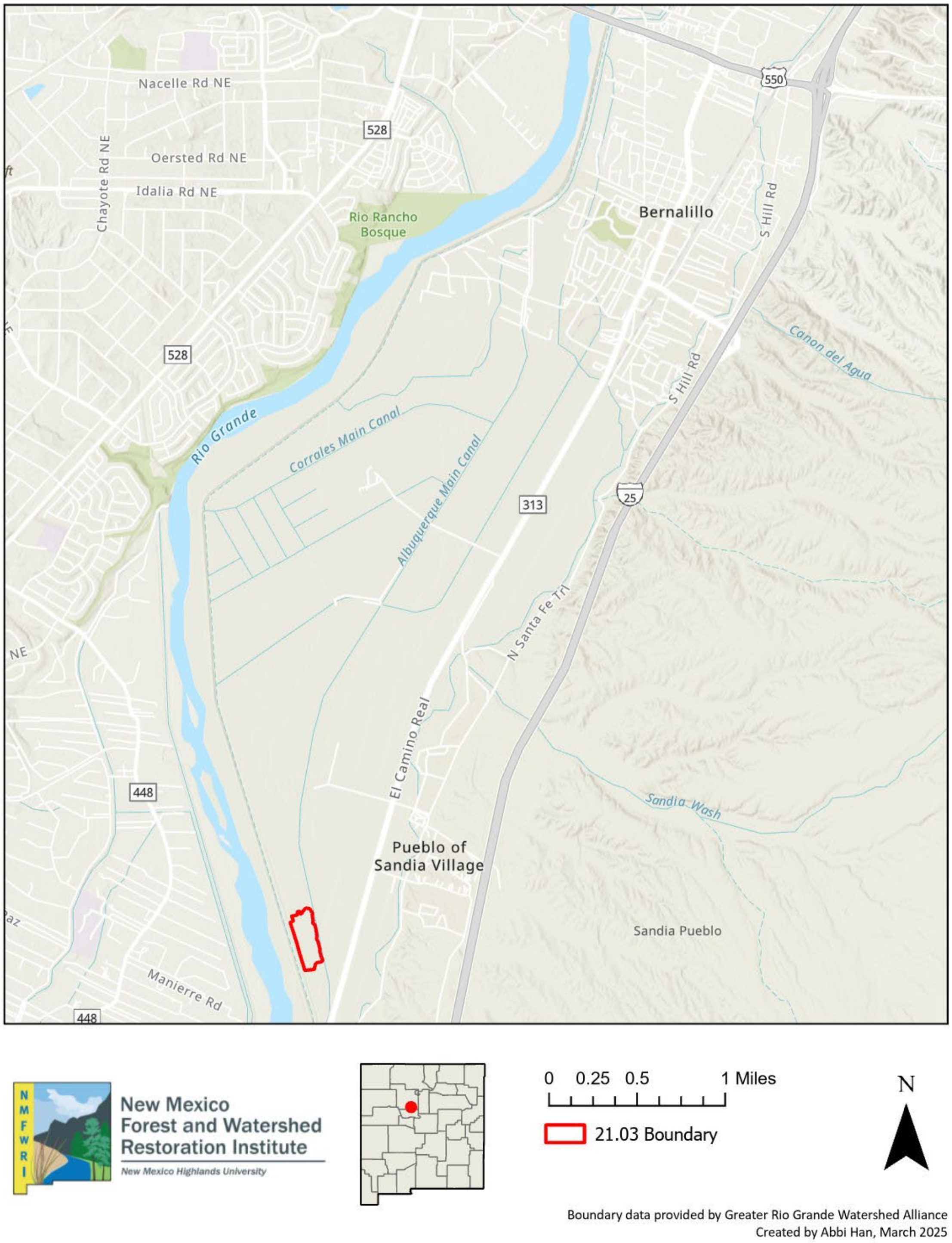


Figure 4. Region map of project 21.03.

Figure 5. Plot locations for project 21.03.

Monitoring Results – Inspection Report

Inspection Report Summary – Sandia Pueblo Invasive Plant Retreatment

On November 15, 2023, Todd Haines performed an inspection of the fall 2023 GRGWA project areas located outside the Bosque East of River Central Pueblo, with the exception of a small area. Totals treated amount to 65 acres of sprayed resprouts. Michael 'Scial' Scialdone accompanied Haines for the inspection. The project is an initial treatment of non-native phreatophyte tree species primarily made up of Russian olive resprouts, salt cedar, Siberian elm and Tree-of-heaven. The project area was previously treated in 2013 and again in 2018, but was considered to have escaped management, so the GRGWA committee saw fit to manage this project as new. Treatment methods included spraying, masticating, and hand treatment. The inspection complies with the established guidelines of the Sandia Pueblo invasive weeds retreatment project.

Discussion

The goal of 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.

It should be noted that the ecological site types as determined by NRCS Web Soil Survey (USDA NRCS, 2023) will not match perfectly to the observed species due to the plantings and restoration projects with certain goals and outcomes.

Much of the grasses present represent what was planted after the 2013 Romero Fire. As expected, Alkali Sacaton is the most abundant species across both projects; this was expected because the grass was seeded as post fire restoration in 2013, and the goal of the project was to increase grassland habitat.

Tall Shrubs structure type was recorded because of the height of the Russian olive present, whose form can be that of either a shrub or tree depending on life stage and habitat. The project area overall was grassland with Russian Olive bordering the canal ditches. Our project boundaries did not include the area directly bordering the ditch where the densest Russian Olive patches were, but it is of good note because of the use of herbicides as a treatment method and the trees' proximity to water. High amounts of litter could be attributed to the accumulation of thatch in an area dominated by grasses which also receives little burning or flooding, major contributors to the reduction in litter.

Monitoring Results – High-Intensity CSE Plot

Overstory Trees

Pretreatment, the living overstory at project 21.02 was made up entirely of Russian Olive, while the dead overstory (snags) was made up of Rio Grande Cottonwoods. Post-treatment, the Russian Olives were no longer present, but the Rio Grande Cottonwood snags remained standing. No overstory trees were observed either monitoring year at project 21.03.

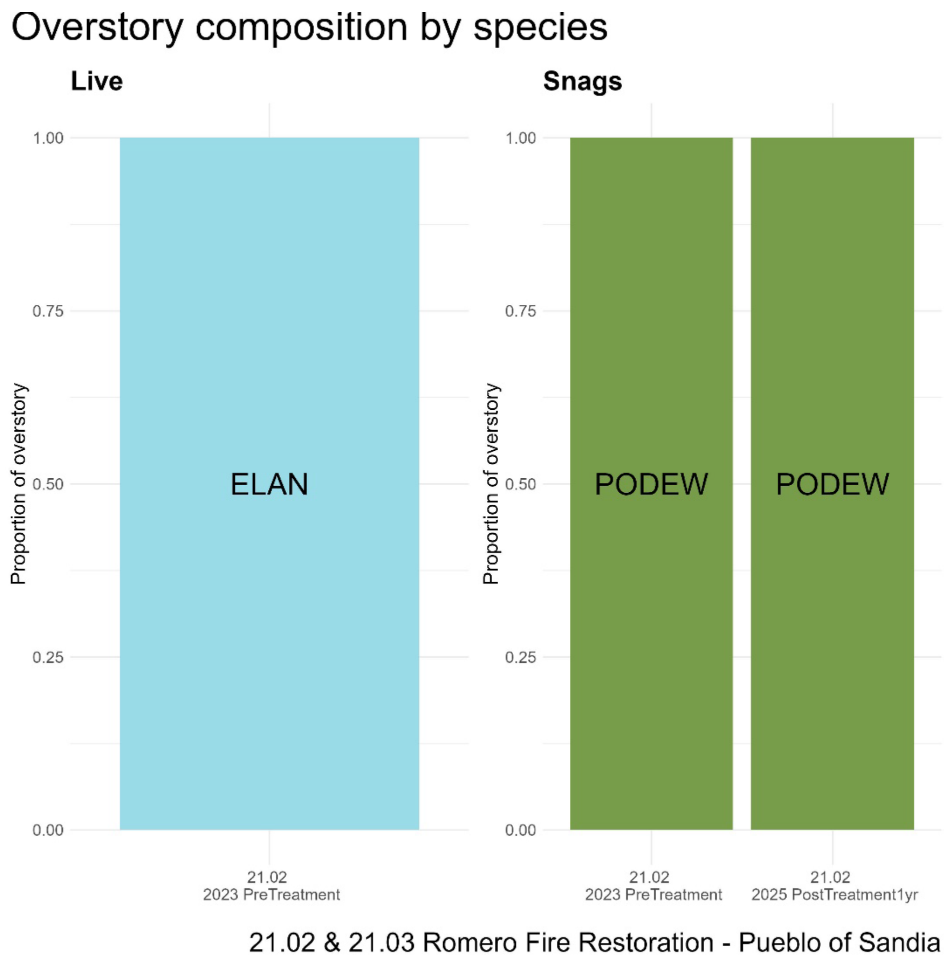


Figure 4. Overstory composition for growing stock trees and snags by species, by project and monitoring status.

Height and Live Crown Base Height

Mean height across the 21.02 growing stock was 21 feet; mean live crown base was 0 feet – meaning that there was no gap between crown growth of the tree and the ground. No live trees were recorded post-treatment

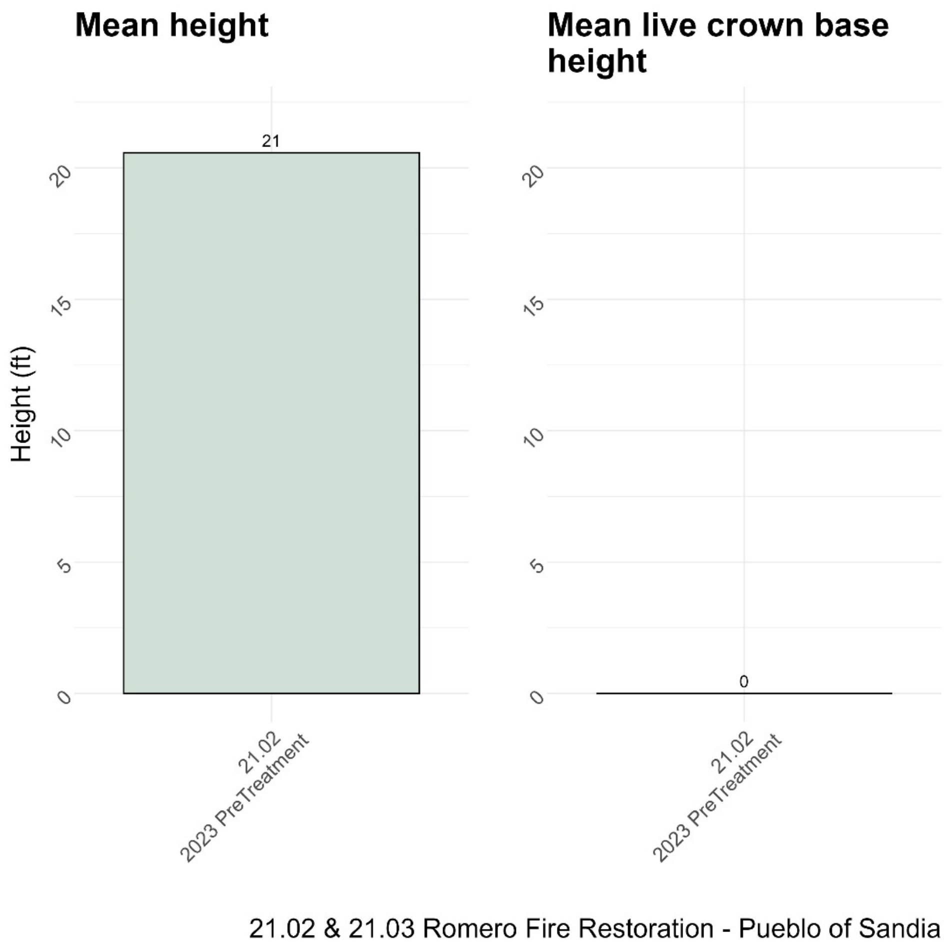


Figure 5. Mean height and mean live crown base height by project and monitoring status.

TPA, BA, QMD

Pretreatment, there were an estimated 30 growing stock trees per acre, and 10 snags per acre. Posttreatment, there were no growing stock trees. Mean snags per acre, mean basal area, and quadratic mean diameter for snags remained approximately the same from pre- to post-treatment. The small variation seen may be due to difference in measurements by crew members, or due to natural decay of snags. See Figure 7 through Figure 9 for a breakdown of these metrics by species.

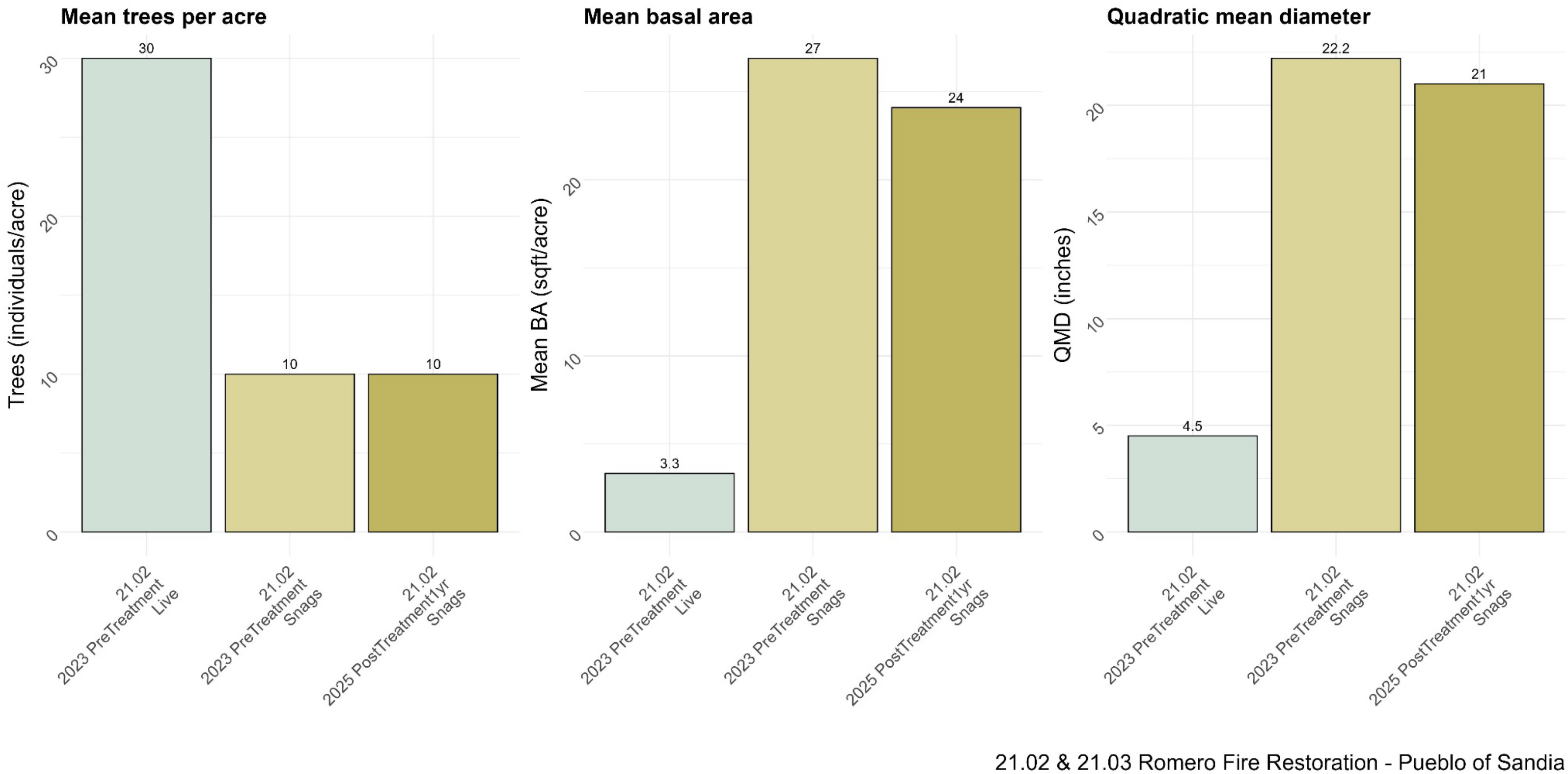


Figure 6. Growing stock and snags metrics by project and monitoring status.

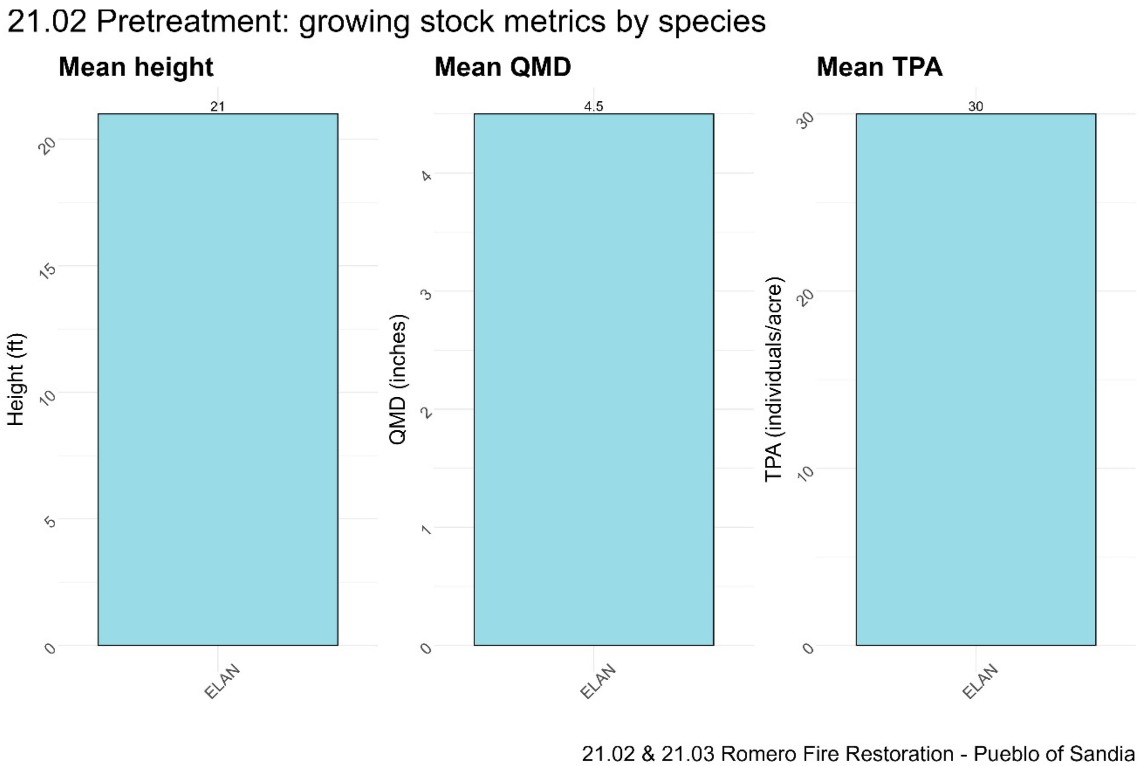


Figure 7. 2023 Pretreatment growing stock metrics by species, 21.02.

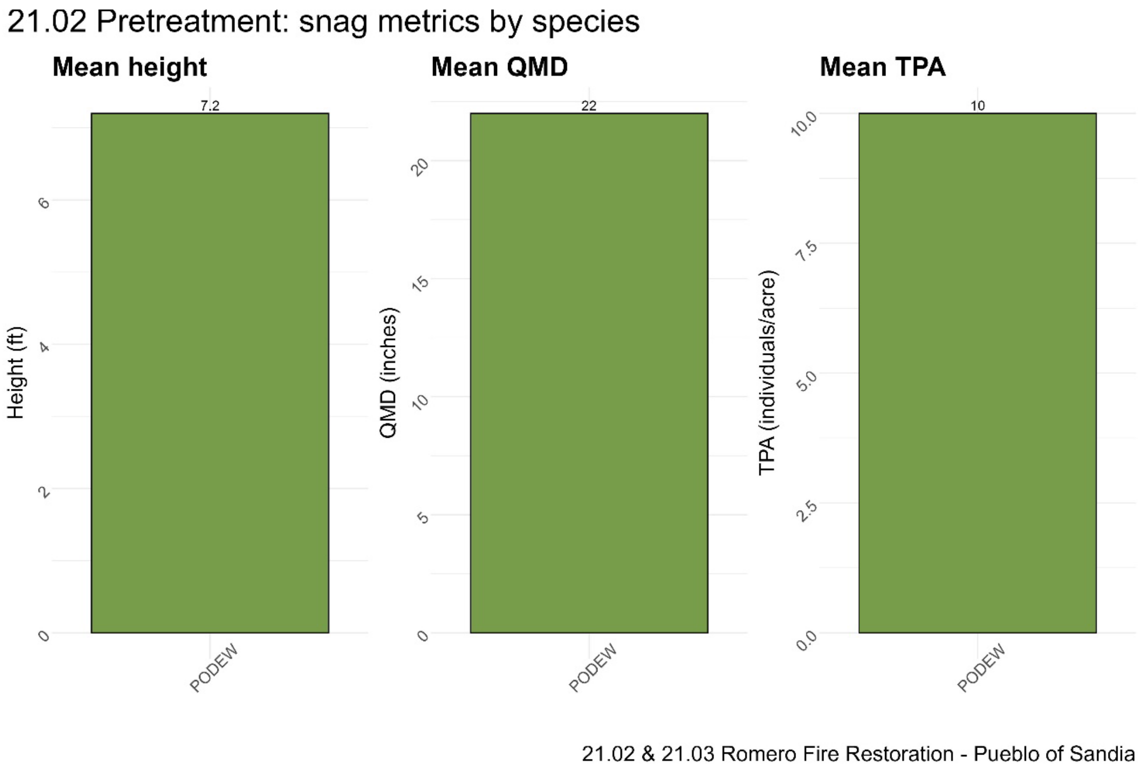


Figure 8. 2023 Pretreatment snag metrics by species, 21.02.

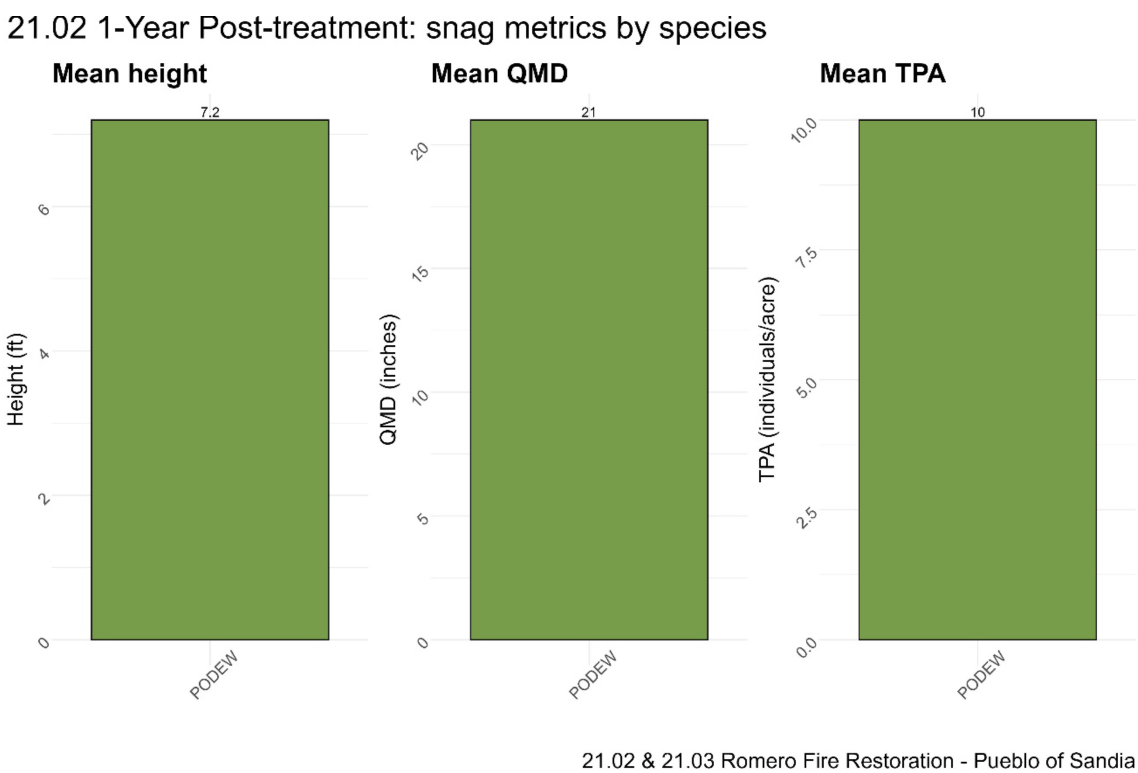


Figure 9. 2025 Post-treatment snag metrics by species, 21.02.

Regeneration: Trees & Shrubs

Pretreatment, 21.02 was observed to have an estimated 120 individuals of Torrey's Wolfberry (LYTO) of seedling stature per acre. Post-treatment, no Wolfberry was observed; the monitoring crew did observe 30 Russian Olive seedlings, and 50 saplings per acre. Treatment activities may have destroyed the shrub growth seen pretreatment, as well as resulted in Russian Olive sprouts from cut mature trees.

21.03 had no observed seedlings pretreatment, and no saplings either monitoring period. Post-treatment, there were 10 Torrey's Wolfberry seedlings per acre recorded. Treatments in this project area may have encouraged shrub growth by reducing competition.

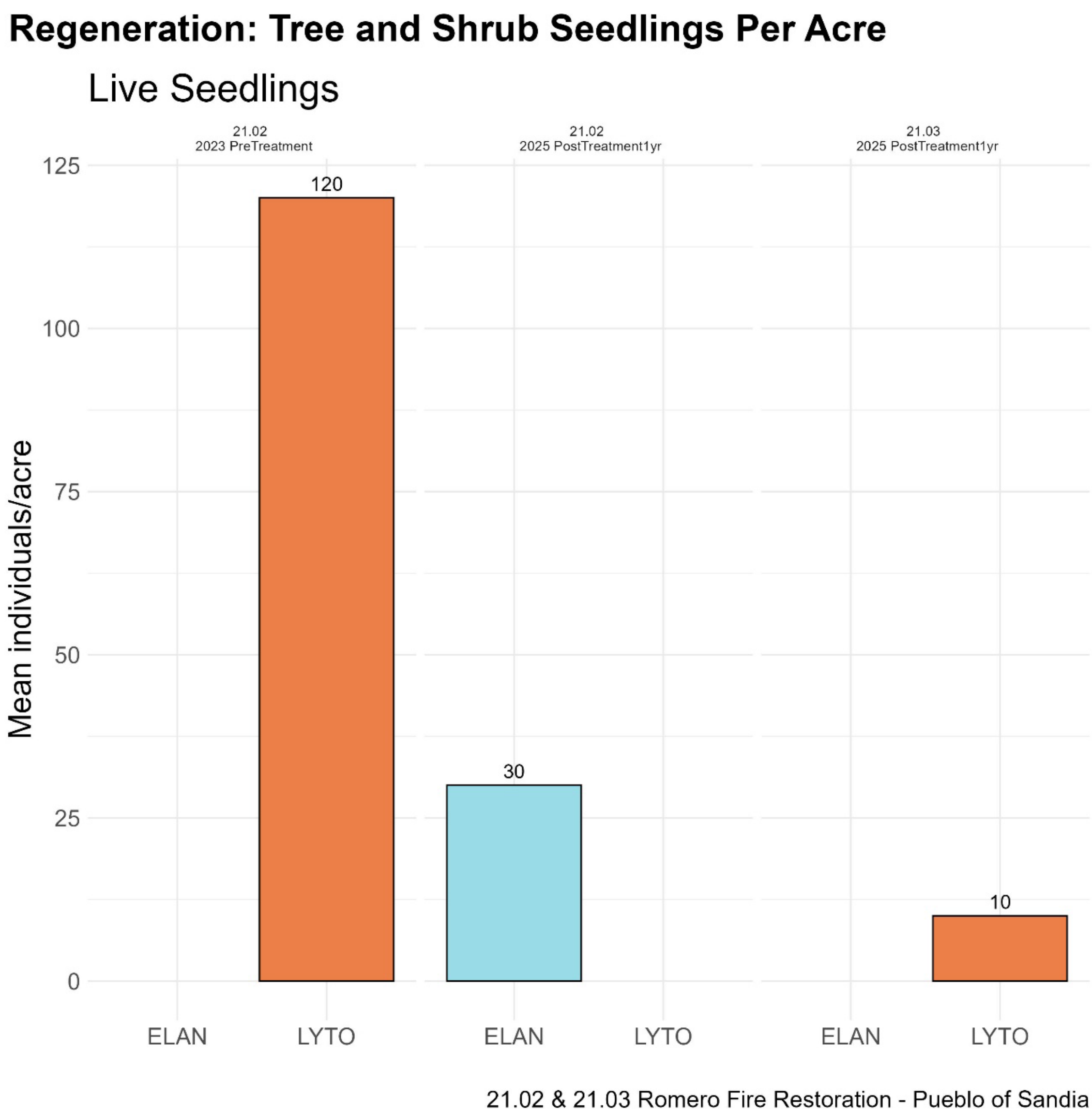


Figure 10. Mean seedlings densities by project and monitoring status. No dead seedlings were recorded during either monitoring period.

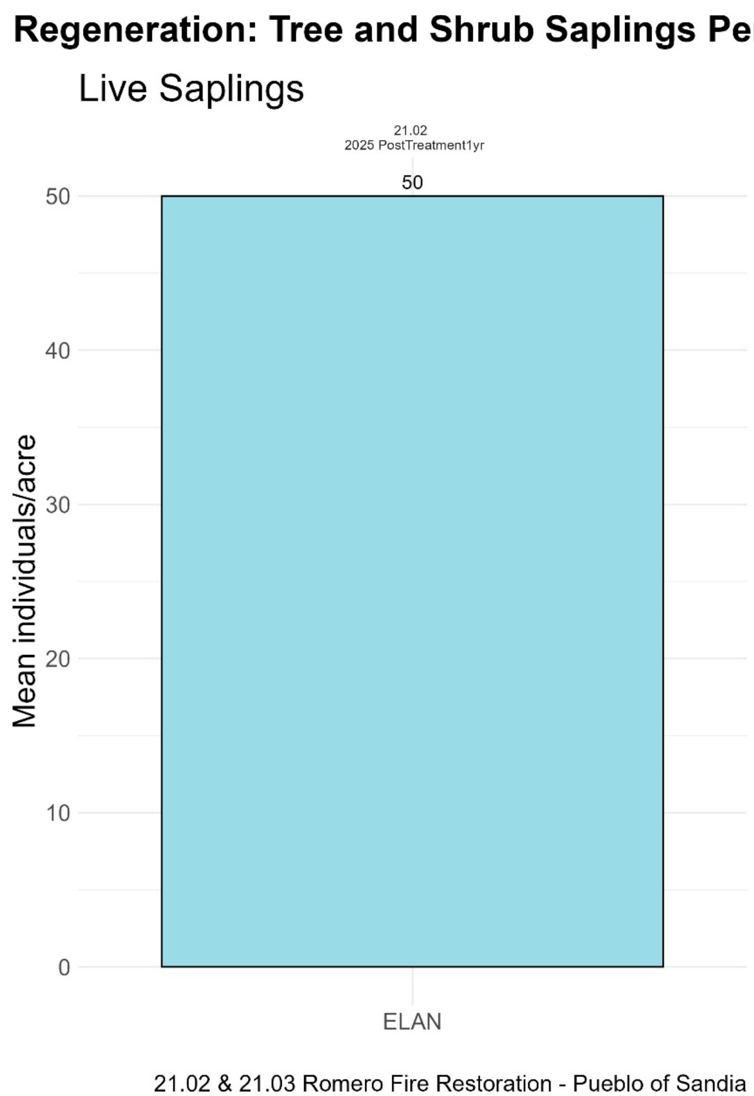


Figure 11. Mean sapling density by species. No dead saplings were recorded during either monitoring period.

Understory and Forest Floor Component

Ground Cover

Within projects 21.02 and 21.03, treatments resulted in an increase in litter cover; and a decrease in plant basal, bole, and bare soil.

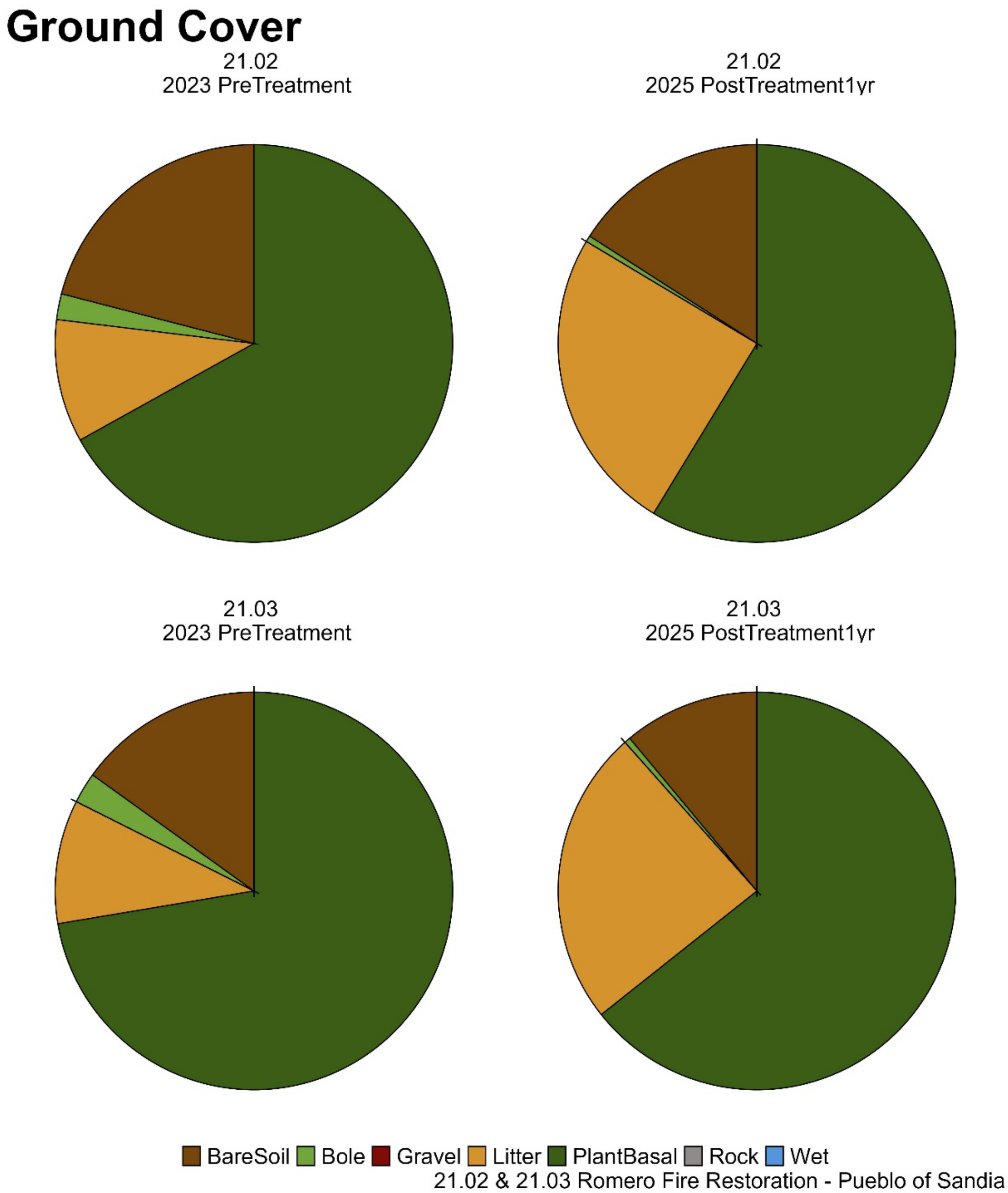


Figure 12. Mean percent ground cover by project and monitoring status.

Table 2. Mean percent ground cover by project and monitoring status.

21.02 & 21.03 Romero Fire Restoration - Pueblo of Sandia		
Monitoring Status	**Cover Class**	**% Cover**
21.02 2023 PreTreatment	PlantBasal	67.00
	Bole	2.10
	Litter	10.00
	BareSoil	21.00
	Rock	
	Gravel	
	Wet	
21.02 2025 PostTreatment1yr	PlantBasal	59.00
	Bole	0.51
	Litter	25.00
	BareSoil	16.00
	Rock	0.00
	Gravel	0.00
	Wet	0.00
21.03 2023 PreTreatment	PlantBasal	72.00
	Bole	2.50
	Litter	10.00
	BareSoil	15.00
	Rock	0.00
	Gravel	0.00
	Wet	0.00
21.03 2025 PostTreatment1yr	PlantBasal	64.00
	Bole	0.50
	Litter	24.00
	BareSoil	11.00
	Rock	0.00
	Gravel	0.00
	Wet	0.00

Aerial Cover

Pretreatment and post-treatment, in both projects 21.02 and 21.03, aerial cover by plant growth class was dominated by live graminoids, followed by dead forbs (Figure 13). The reason for high dead forb cover but low living cover is likely due to the time of year at which monitoring occurred. Pretreatment, both projects had majority native species (63.6% and 85.7%). Posttreatment, aerial cover by native plant species increased to 77.8% in 21.02; but in 21.03, native species cover decreased to 57.1% (Table 2). This is common in restoration treatments, as treatments cause disturbance that many nonnative species take advantage of. Across both projects and monitoring periods, the most dominant plant species was living *Sporobolus airoides* (Alkali Sacaton, SPAI): this grass was seeded in these projects in 2013.

Table 3. Percent of native and nonnative species recorded in aerial cover.

21.02 & 21.03 Romero Fire Restoration - Pueblo of Sandia		
Monitoring Status	**% Native Species**	**% Nonnative Species**
21.02 2023 PreTreatment	63.6	36.4
21.02 2025 PostTreatment1yr	77.8	22.2
21.03 2023 PreTreatment	85.7	14.3
21.03 2025 PostTreatment1yr	57.1	42.9

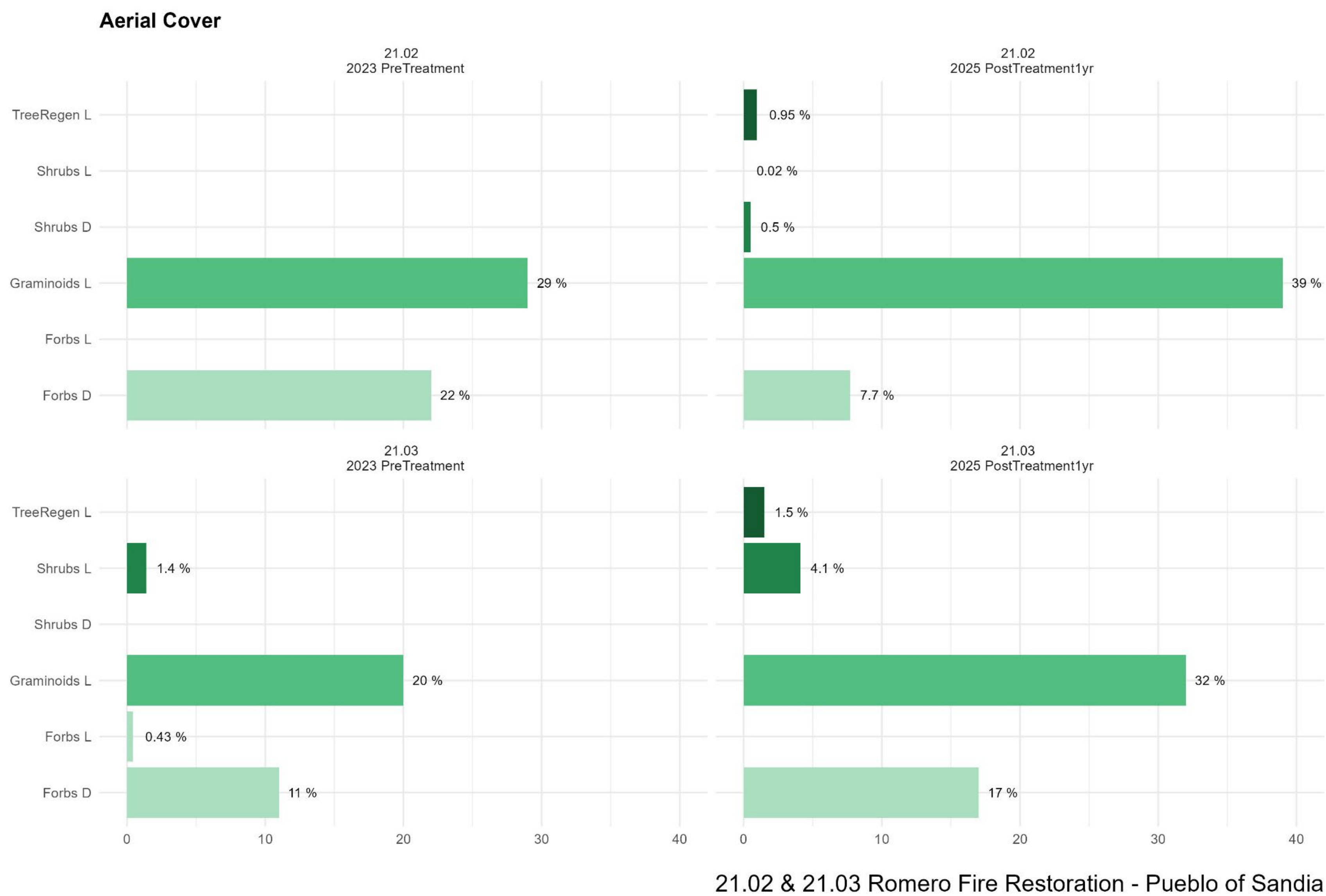


Figure 13. Mean aerial cover by project and monitoring status.

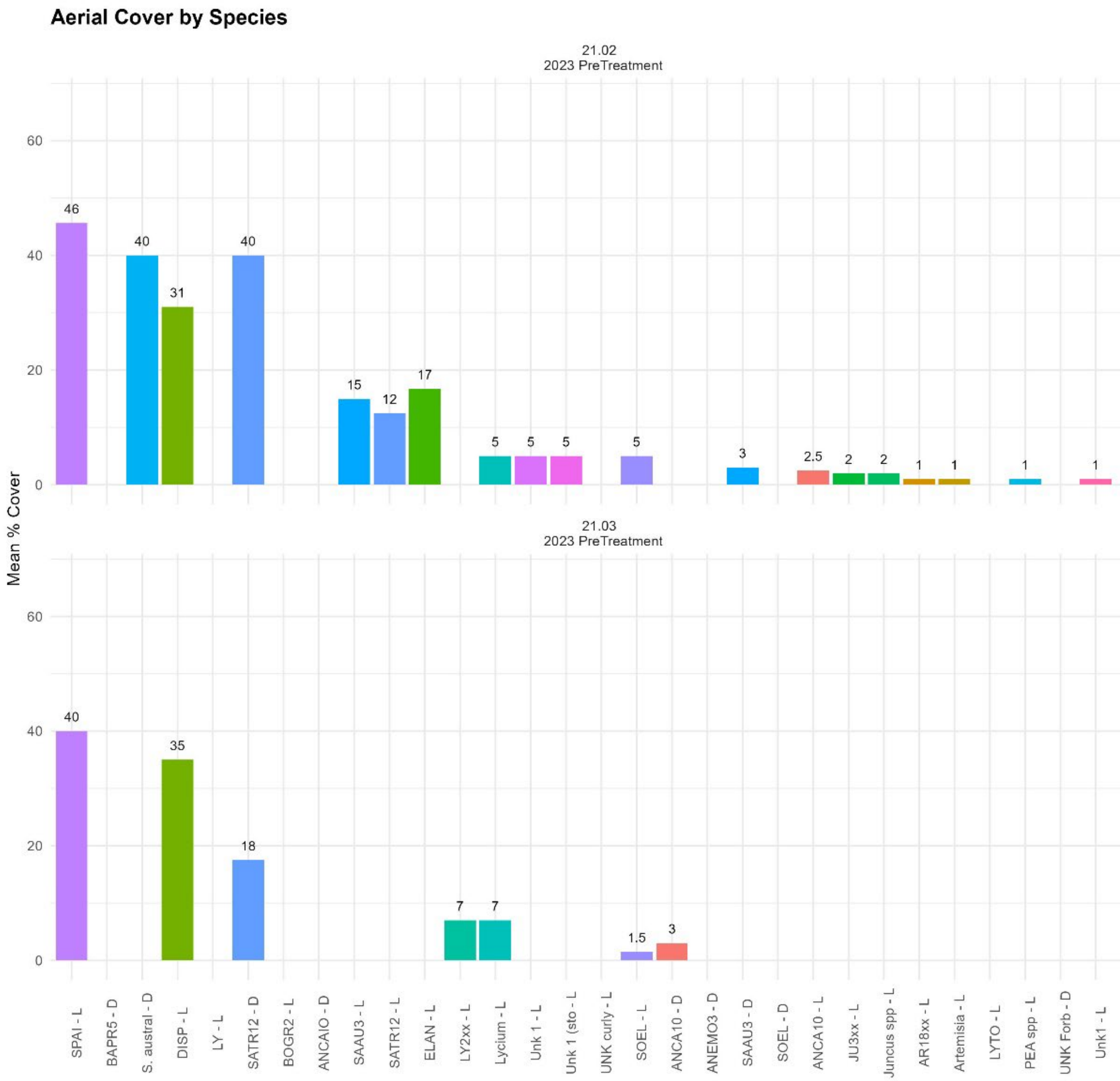


Figure 14. 2023 Pretreatment mean percent cover by species, living (L) and dead (D).

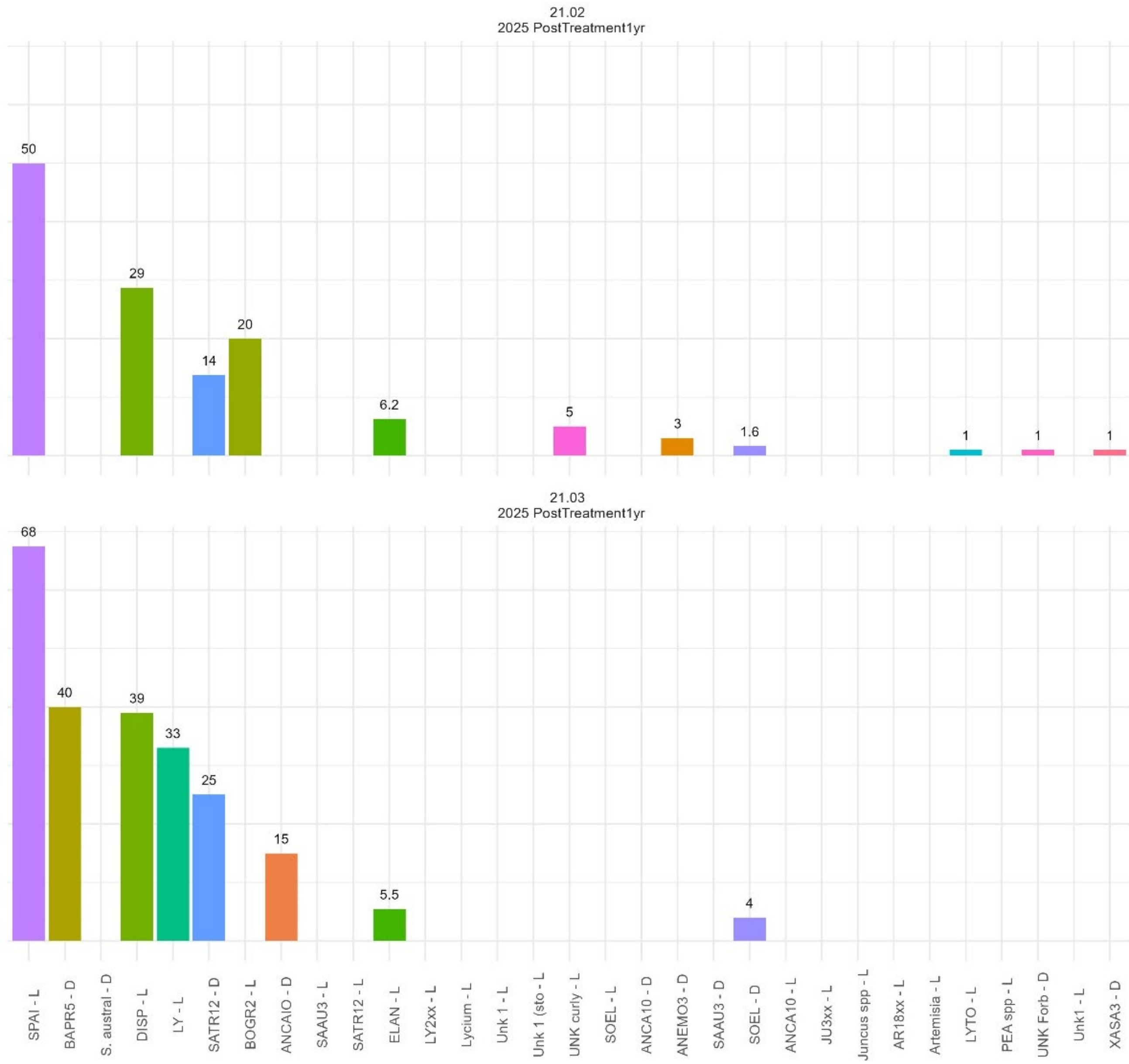


Figure 15. 2025 Post-treatment mean percent cover by species, living (L) and dead (D).

USDA Plant Code	Common Name	Scientific Name	Nativity
AIAL	Tree of heaven	Ailanthus altissima (Mill.) Swingle	I
ANCA10	Yerba mansa	Anemopsis californica (Nutt.) Hook. & Arn.	N
ARPUF	Fendler's threeawn	Aristida purpurea Nutt. var. fendleriana (Steud.) Vasey	N
BASC5	Burning bush; Kochia	Bassia scoparia (L.) A.J. Scott	I
BAPR5	Forage kochia	Bassia prostrata	I
BOER4	Black grama	Bouteloua eriopoda (Torr.) Torr.	N
BOGR2	Blue grama	Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths	N
BRTE	Cheatgrass/downy brome	Bromus tectorum L.	I
DEPI	Western tansymustard	Descurainia pinnata (Walter) Britton	N
DISP	Saltgrass	Distichlis spicata (L.) Greene	N
ELAN	Russian olive	Elaeagnus angustifolia L.	I
ELEL5	Squirreltail	Elymus elymoides (Raf.) Swezey	N
FOPU2	Stretchberry	Forestiera pubescens Nutt.	N
LASE	Prickly lettuce	Lactuca serriola L.	I
LY	Wolfberry	Lycium sp.	N
LYTO	Torrey wolfberry	Lycium torreyi A. Gray	N
MACHA	Tansyaster	Machaeranthera Nees	N
PLJA	James' galleta	Pleuraphis jamesii Torr.	N
PODEW	Rio Grande Cottonwood	Populus deltoides W. Bartram ex Marshall	N
SAEX	Narrowleaf willow	Salix exigua Nutt.	N
SAGO	Goodding's willow	Salix gooddingii C.R. Ball	N
SATR12	Prickly Russian thistle	Salsola tragus L.	I
SOEL	Silverleaf nightshade	Solanum elaeagnifolium Cav.	N
SPAI	Alkali Sacaton	Sporobolus airoides (Torr.) Torr.	N
SPCO4	Scarlet globemallow	Sphaeralcea coccinea (Nutt.) Rydb.	N
TACH2	Five stamen tamarisk	Tamarix chinensis Lour.	I
TARA	Salt cedar	Tamarix ramosissima Ledeb.	I
ULPU	Siberian elm	Ulmus pumila L.	I

Canopy Cover

In project 21.02, mean canopy cover decreased from 6.6% to 0.88%; this is consistent with the removal of non-native growing stock trees during treatment (Figure 4). In project 21.03, mean canopy cover increased from 2.6% to 11%; the reason for this increase is uncertain.

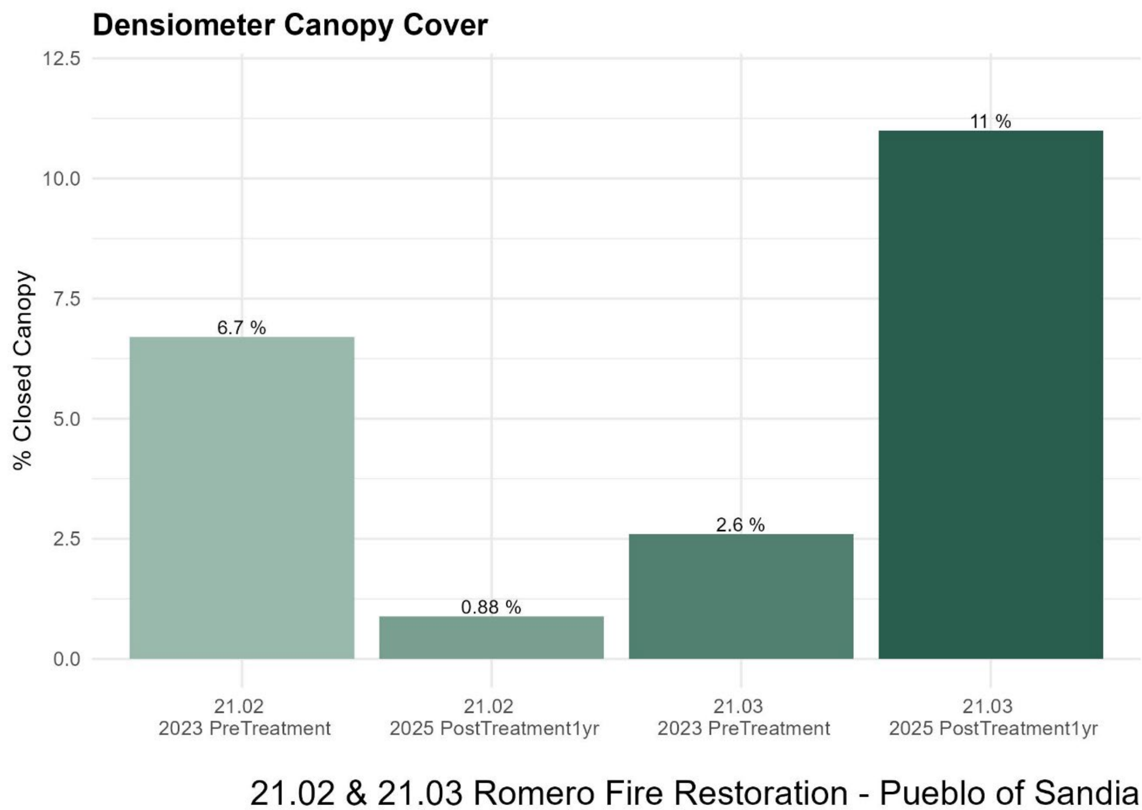


Figure 16. Mean percent closed canopy cover by project and monitoring status.

Soils

Pretreatment, the most frequently observed soil texture was clay loam in 21.02 and loamy sand in 21.03. Post-treatment, the most frequently observed soil texture was sandy loam in 21.02 and silty clay loam in 21.03. Please note that there is a small level of uncertainty and variation in soil texture results depending on the observer. There are also multiple factors that may affect soil texture changes aside from treatments, such as wind, precipitation, flooding, and runoff.

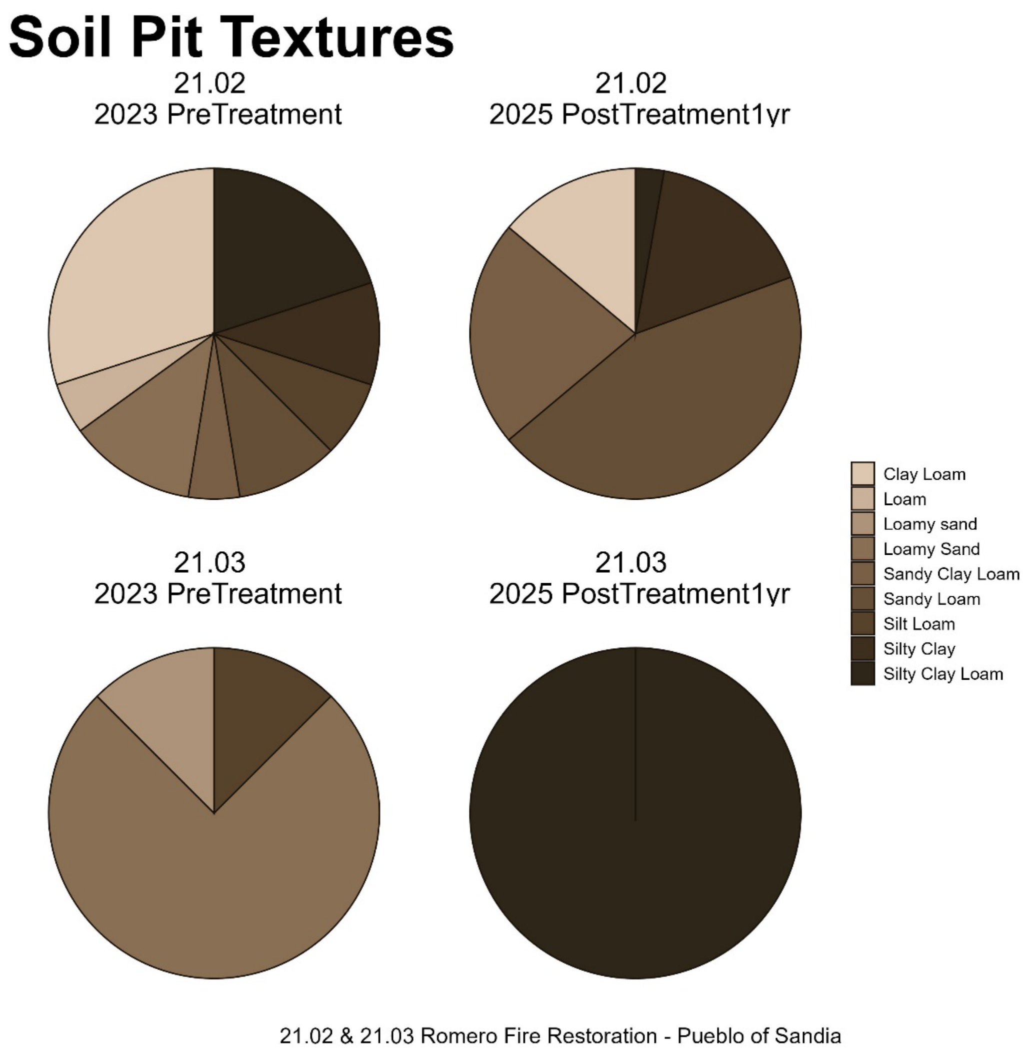


Figure 17. Frequency of soil textures by project and monitoring period.

Table 4. Frequency of soil textures by project and monitoring status.

Soil Texture Frequency: 21.02 & 21.03 Romero Fire Restoration - Pueblo of Sandia		
Monitoring Status	**Soil Texture**	**Count**
21.02 2023 PreTreatment	Clay Loam	12
	Silty Clay Loam	8
	Loamy Sand	5
	Sandy Loam	4
	Silty Clay	4
	Silt Loam	3
	Loam	2
	Sandy Clay Loam	2
21.02 2025 PostTreatment1yr	Sandy Loam	16
	Sandy Clay Loam	8
	Silty Clay	6
	Clay Loam	5
	Silty Clay Loam	1
21.03 2023 PreTreatment	Loamy Sand	6
	Loamy sand	1
	Silt Loam	1
21.03 2025 PostTreatment1yr	Silty Clay Loam	8

Surface Fuels

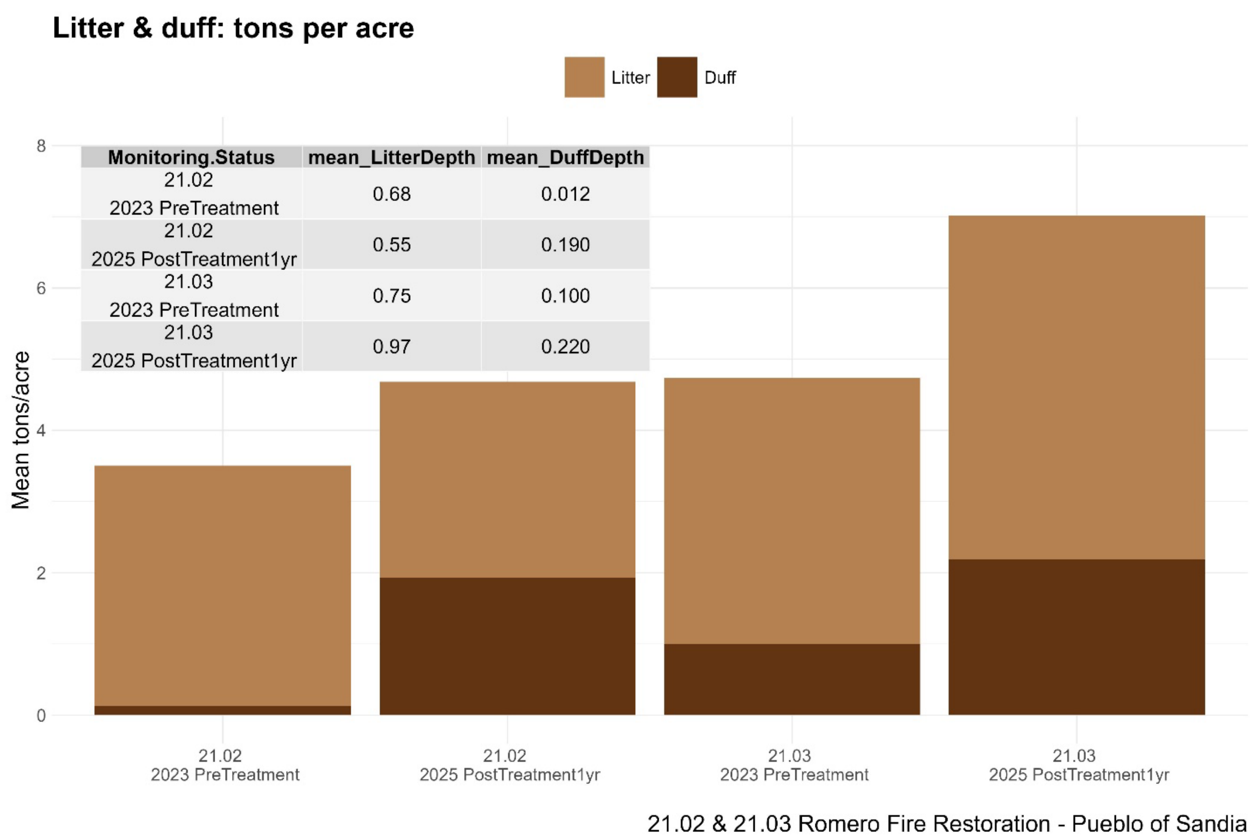
Overall, total surface fuels and total woody fuels decreased in project 21.02, but total fine fuels increased. Total fine fuels, woody fuels, and all surface fuels increased substantially in project 21.03. Further discussion is included below.

Table 5. Mean tons per acre of surface fuels by project and monitoring status.

21.02 & 21.03 Romero Fire Restoration - Pueblo of Sandia										
Monitoring Status	**1-hr (tons/acre)**	**10-hr (tons/acre)**	**100-hr (tons/acre)**	**1000-hr sound (tons/acre)**	**1000-hr rotten (tons/acre)**	**Litter (tons/acre)**	**Duff (tons/acre)**	**Total Fine Fuels (tons/acre)**	**Total Wood Fuels (tons/acre)**	**Total Surface Fuels (tons/acre)**
21.02 2023 PreTreatment	0.046	0.43	0.71	59		3.4	0.12	1.2	60	63
21.02 2025 PostTreatment1yr	0.05	0.88	1.2	7.9	22	2.8	1.9	2.1	32	37
21.03 2023 PreTreatment	0.032	0.3	0	0.31		3.7	1	0.34	0.65	5.4
21.03 2025 PostTreatment1yr	0.044	0.38	2.6	48		4.8	2.2	3	51	58

Litter and Duff

Litter and duff loads (tons per acre) and depths (inches) increased in both projects from pre- to post-treatment. The increase in litter is a natural part of seasonal cycles, and is also likely due to the mastication portion of treatments. The increase in duff is due to the natural decay of litter. Accumulation of litter increases moisture in litter layers, which can hasten decay and thus the transition from litter to duff.



Monitoring.Status	mean_LitterDepth	mean_DuffDepth
21.02 2023 PreTreatment	0.68	0.012
21.02 2025 PostTreatment1yr	0.55	0.190
21.03 2023 PreTreatment	0.75	0.100
21.03 2025 PostTreatment1yr	0.97	0.220

Figure 18. Mean litter and duff loans in tons per acre by project and monitoring status. Mean litter and duff depths are represented in inches.

Fine Fuels

Fine fuels across both projects increased from pre- to post-treatment. This is likely due to both natural fuel accumulations as well as mastication treatments on nonnative woody species.

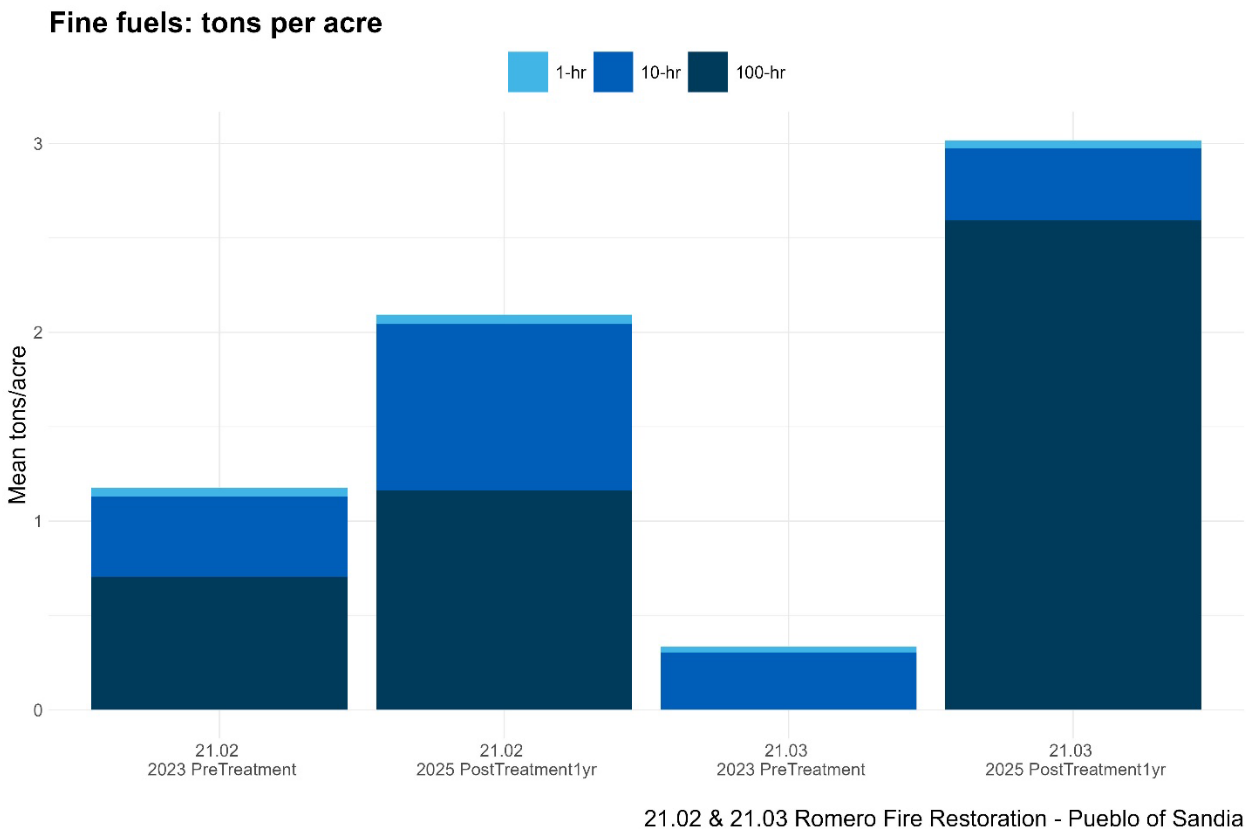


Figure 19. Mean fine fuel loads in tons per acre by project and monitoring status.

Thousand-Hour Fuels

Thousand-hour fuels in project 21.02 transitioned from 59 tons per acre of sound fuels to a total of 29.9 tons per acre of both sound and rotten fuels. Some of the thousand-hour fuels recorded pretreatment may have been masticated during treatments, accounting for the overall decrease. Thousand-hour fuels in project 21.03 increased substantially from 0.31 tons per acre to 48 tons per acre of sound thousand-hour fuels. Photos show many large snags felled in the project area post-treatment.

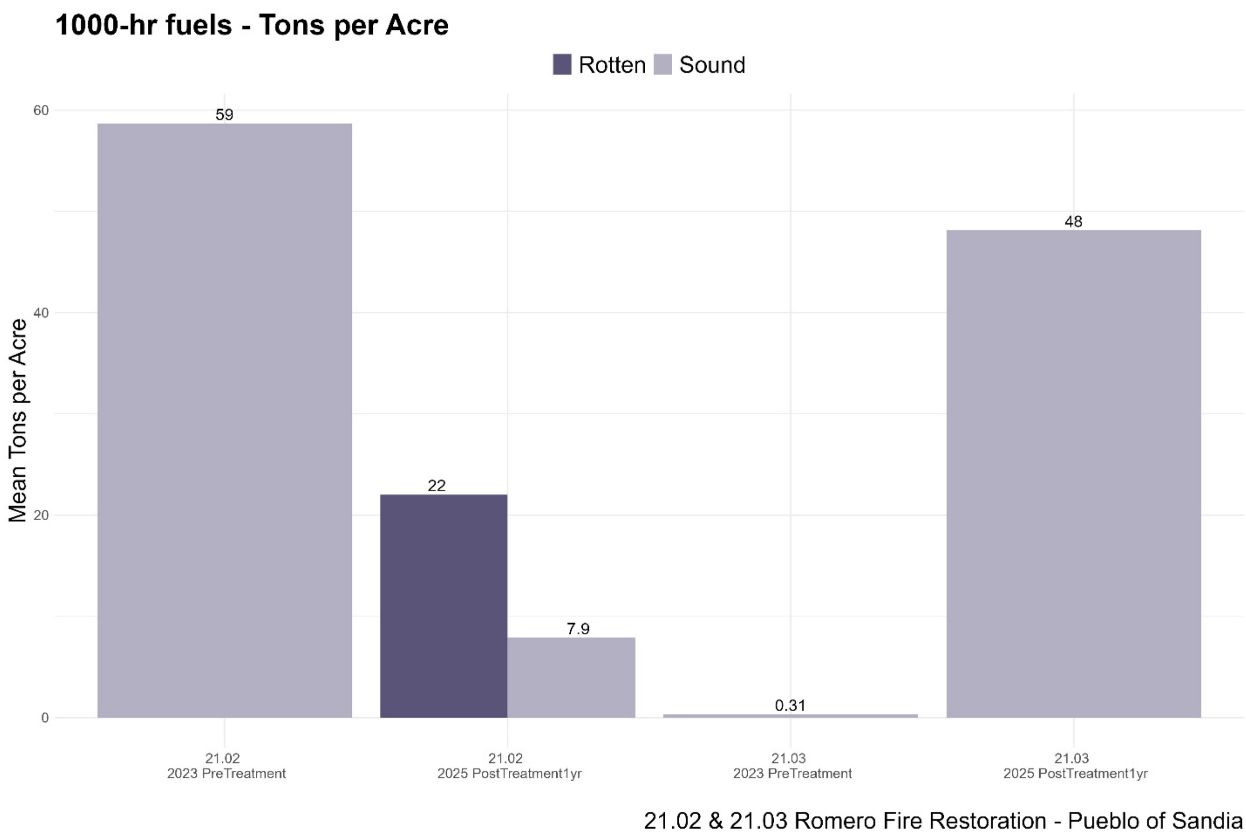


Figure 20. Thousand-hour fuels in tons per acre by decay status, project and monitoring status.

Figure 21. Proportion of thousand-hour fuels by decay classes, project and monitoring status.

Summary

Data Summary

21.02 Retreatment

The field crew observed a low diversity and density of tree species in the 21.02 retreatment project area – the only living tree species recorded was Russian olive and snags recorded were all Rio Grande Cottonwood (Figure 4). Following treatments, Russian olive was no longer found in the project area (Figure 4). However, Russian olive resprouts were also recorded post-treatment (30 seedlings, 50 saplings per acre, Figure 10, Figure 11). Pretreatment, shrub seedlings were present in the project area (120 seedlings per acre, Figure 10). There were no damages recorded to any trees, living or dead.

Pre- and post-treatment, the dominant growth form of vegetation by percent cover in plots was graminoids (grass-like), followed by forbs (herbaceous flowering plants). The proportion of native species increased after treatments, to 77.8% of all species (Table 3). The three most common species in plots pretreatment were Alkali Sacaton (SPAI), *Salsola tragus* and tumbleweed (SATR12) (Figure 13). Post-treatment, plots were dominated by Alkali Sacaton, saltgrass (DISP), and blue grama (BOGR2).

The dominant soil textures recorded in the project area pretreatment were clay loam and silty clay loam; sandy loam and sandy clay loam were dominant post-treatment (Figure 17, Table 4).

Total surface fuel loads declined following treatments, but total loans of fine fuels, litter, and duff increased (Table 5). Because thousand-hour fuels decreased in tandem, we can assume that increases in these other fuels loads is due to the mastication portion of treatments. Total percent cover of litter in plots also increased post-treatment.

21.03 Retreatment

No overstory trees were recorded in the 21.03 retreatment project area pre- or post-treatment. Other woody growth was observed, in the form of Torrey's wolfberry (LYTO) recorded in regeneration. Density of the shrubs decreased from 120 individuals per acre pretreatment, to 10 individuals per acre post-treatment (Figure 10).

Pre- and post-treatment, the dominant growth form of vegetation by percent cover in plots was graminoids (grass-like), followed by forbs (herbaceous flowering plants). The proportion of native species decreased after treatments, from 85.7% to 57.1% of all species (Table 3). This is common in restoration treatments, as treatments cause disturbance that many nonnative species take advantage of. The three most common species in plots pretreatment were Alkali Sacaton (SPAI), saltgrass (DISP), and tumbleweed (SATR12) (Figure 13). Post-treatment, plots were dominated by Alkali Sacaton, forage kochia (BAPR5), and saltgrass.

The dominant soil textures recorded in the project area pretreatment were loamy sand and silty loam; silty clay loam was dominant post-treatment (Figure 17, Table 4).

Total surface fuel loads in all categories increased following treatments (Table 5). Total percent cover of litter in plots also increased post-treatment.

Management Implications

21.02 Retreatment

Russian olive trees cut in treatments are resprouting as of post-treatment monitoring, some reaching sapling heights (4.5ft). Despite this, the majority of species in the measured plots were native species. Continued cutting and spraying of Russian olives will be required to maintain results. Although native species were dominant, diversity of species was still relatively low. Increased biodiversity in the understory would be beneficial for nutrient cycling, wildlife habitat, and soil stability.

Total surface fuels decreased after treatments, but fuel size class transitioned drastically. While thousand-hour fuels were masticated and thus decreased, fine fuels increased – this may present an increased fire risk because these fuels can catch fire more quickly and can be blown in the wind. The 21.02 project area will require future monitoring and continued treatments.

21.03 Retreatment

No overstory trees were recorded in the 21.03 retreatment project – low densities of native shrubs were recorded as well as dominance by grasses and forbs. Depending on long-term ecosystem goals, managers may be inclined to plant woody species to transition the site to a woodland. The majority of species recorded were native, but that proportion decreased by approximately 30% post-treatment. The dominant species was a native, planted grass, Alkali sacaton. Total diversity of plant species was relatively low in plots. Increased plant diversity would be beneficial for nutrient cycling, wildlife habitat, and soil stability.

All surface fuel load classifications increased following treatments. This presents increased fire risk. Additional monitoring is needed to determine ongoing adaptive management strategies as the post-treatment ecosystem develops.

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. This 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 timber sales. NMFWRI shall not be held liable for improper or incorrect use of the data described and/or contained in this report.

Analysis was also done according to our standard protocols. Note that the values reported in the tables are expressed on a per acre basis, but represent only area actually sampled. We do not scale up these values to calculate volume of wood over the project area, and warn readers of this report that they are not intended for that purpose. The accompanying tables show summaries of our data, and some differences are discussed below; however, differences that seem apparent here may not stand up to rigorous statistical tests. For some estimates, the standard deviation exceeds the mean (i.e., the coefficient of variation is greater than 100 percent), and sampling errors for some estimates exceed 100 percent. Therefore, data should be used and results interpreted with appropriate caution.

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Appendix I: Sample Point Location Table

ID	latitude	longitude
21.02_1	35.2538044	-106.5872141
21.02_2	35.26135464	-106.5909809
21.02_3	35.2557222	-106.5881566
21.02_4	35.26257978	-106.5903388
21.02_5	35.25523203	-106.58793
21.02_6	35.25962	-106.588852
21.02_7	35.2537332	-106.5861279
21.02_8	35.2584989	-106.5863291
21.02_9	35.248935	-106.585632
21.02_10	35.250266	-106.58711
21.03_1	35.247169	-106.584543
21.03_2	35.244604	-106.583843

Appendix II: Photo pages, by site

Photolog details are available upon request.

Photos taken during these monitoring efforts cannot be shared with the public due to the Pueblo of Sandia’s privacy laws.

Appendix III – Modified Hink and Ohmart categories, from NMRAM

The following is pages 39-41 in Muldavin et al.'s 2014 NMRAM for Montane Riverine Wetlands v 2.0 Manual 2021 (Muldavin E. E., 2021)

Vegetation Vertical Structure Type Definitions for NMRAM

Multiple-Story Communities (Woodlands/Forests)

Type 1- High Structure Forest with a well-developed understory. Trees (>6 m) with a canopy covering >25% of the area of the community polygon and woody understory layer of tall shrubs or short trees (1.5-6 m) covering >25% of the area of the community (polygon). Substantial foliage is in all height layers.

Type 2 -Low Structure Forest with little or no understory. Trees (>6 m) with canopy covering >25% of the area of the community polygon and minimal woody understory layer (1.5-6 m) covering <25% of the area of the community (polygon). Majority of foliage is over 7 m above the ground.

Single-story Communities (Shrublands, Herbaceous and Bare Ground

Type 5 -Tall Shrubland. Young tree and shrub layer (1.5-6 m) covering >25% of the area of the community polygon. Stands dominated by tall shrubs and young trees, may include herbaceous vegetation underneath the woody vegetation.

Type 6S- Short Shrubland. Short stature shrubs or very young trees (>1.5 m) covering >25% of the area of the community (polygon). Stands dominated by short woody vegetation, may include herbaceous vegetation among the woody vegetation.

Type 6W- Herbaceous Wetland. Herbaceous wetland vegetation covering >10% of the area of the community polygon. Stands dominated by obligate wetland herbaceous species. Woody species absent, or <25% cover.

Type 6H- Herbaceous vegetation. Herbaceous vegetation covering >10% of the area of the community polygon. Stands dominated by herbaceous vegetation of any type except obligate wetland species. Woody species absent or <25% cover.

Type 7-Sparse Vegetation, Bare Ground. Bare ground, may include sparse woody or herbaceous vegetation, but total vegetation cover <10%. May be natural disturbance in origin (e.g., cobble bars) or anthropogenic (e.g., roads).