Great Basin Institute - Nevada Conservation Corps - Evaluation Report

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Introduction

Great Basin Institute (GBI) is an interdisciplinary field studies organization that promotes environmental research, education, and conservation throughout the West. A public 501 (c)(3) nonprofit, the institute advances ecological literacy and habitat restoration through educational outreach and direct service programs. The Nevada Conservation Corps (NCC), a program of GBI, is an environmental service program dedicated to promoting field research and direct conservation service. NCC has administered 23 continuous AmeriCorps program years. The Corps supports Nevada's communities and public lands through the deployment of technically proficient forestry restoration teams to mitigate fire threats, reduce the spread of invasive species, and restore and re-designate trails. NCC's trained monitoring and assessment teams capture critical data on the condition of forest and rangeland health.

NCC's program activities include crew-based services that reduce wildland fire threat through fuels reduction and habitat restoration. In addition to such services, Corps members treat and abate noxious weeds, as well perform tasks such as post-fire re-seeding and native plant re-introduction. Trail management measures, including the designation and restoration of trail routes, also support reduction of fire threat by reducing fuels along trail corridors, maintaining fuel breaks, and offering improved access to fire locations. To support agency decision-making and capture indicators of accomplishment, NCC's Assessment, Inventory, and Monitoring teams evaluate and characterize forest and range health conditions and provide data to determine restoration efficacy. The primary anticipated short-term outcomes targeted by NCC program activities include reducing the risk of catastrophic wildfire; increasing accessibility and safe condition of usable recreational trail systems; and developed publications on monitoring protocols.

GBI contracted with the Center for Program Evaluation at the University of Nevada, Reno to design and evaluate the NCC program in the 2021-2023 grant cycle. This report describes the results of grant years 1 and 2 (2021 and 2022) of an impact evaluation for GBI's NCC. The goal of the evaluation is to evaluate the impact and efficacy of wildfire fuels reduction on reducing wildfire risk for Nevada's public lands.

Methods

Research Question. For the impact evaluation, a pre-post quasi-experimental design (QED) study was conducted with a matched comparison group to answer the research question:

> *Did Nevada Conservation Corps fuels reduction treatments have an impact on decreasing fuel load and therefore reduce wildfire risk for Nevada's public lands compared to similar sites where fuels were not treated?*

Study Design. A QED was chosen because random selection of treatment sites was not feasible since projects and locations are determined by the needs of project partners. The QED will compare mean changes in fuel load from pre-treatment to post-treatment for project sites and for untreated comparison sites. Typically, fuel models are used in fire behavior prediction systems. These models supply average fuel loads for each different fuel type and size class. The output of this study are the measurements of fuel loading in weight per acre for each fuel class. The amount and type of available fuel has direct effects on fire behavior, smoke production, ecological consequences, and fire risk. Higher fuel load measurements (depending on size and type) indicate a higher fire intensity and thus a higher risk of catastrophic fire.

Project Work Description. Data was collected before and after 4 different fuels reduction treatments during this evaluation period:

614: Steptoe Valley Habitat Restoration and Fuels Reduction 2021 (BLM Ely District Office)

Description: The overall objective was to complete thinning in priority sagebrush areas to improve sage-grouse habitat and rangeland health, reduce fire risk, and provide biomass to the public. The work location used in this study was a unit that had previously been cleared by chaining, and NCC crews performed maintenance by cutting any pinyon pine and juniper trees growing inside the unit. Trees were sparse on most of the unit and young – generally less than 5 feet in height. Project work and data collection took place in November, 2021.

Treatment Specifications: All trees within the designated areas are to be cut at the base (stump height not to exceed 6 inches) and the tree is to be scattered to a height not to exceed 24 inches above ground level. All limbs and sprouts are to be removed from the stump to prevent stump spouting and regrowth.

816-A: Karlo Road Juniper Removal 2022 (BLM Eagle Lake Field Office)

Description: Similarly to the work in Steptoe Valley, this project aimed to reduce wildfire fuels and improve rangeland health and sage grouse habitat. The area contained several archeological sites, which limited cutting to smaller trees in order to minimize disturbance. Project work and data collection took place in November, 2022.

Treatment Specifications: All trees under 5 feet in height within the designated area are to be cut at the base (stump height not to exceed 6 inches). The tree is to be scattered to a height not to exceed 24 inches above ground level. All limbs and sprouts are to be removed from the stump to prevent stump spouting and regrowth.

816-A: Rock Spring Juniper Removal 2023 (BLM Applegate Field Office)

Description: This project aims to restore a spring exclosure that has seen heavy disturbance and Juniper encroachment over the years. Crews are working to remove Juniper trees from the interior of the exclosure, as well as the surrounding area. Project work and data collection took place in September, 2023.

Treatment Specifications: All Juniper trees, excluding old growth, inside the exclosure were cut at the base (stump height not to exceed 6 inches). Slash was placed in 6'x6' burn piles, except in riparian zones, where crews built 3'x3' loosely-packed habitat piles to minimize disturbance.

816-A: Big Springs Juniper Maintenance 2023 (BLM Eagle Lake Field Office)

Description: This project once again aimed to reduce wildfire fuels and improve rangeland health and sage grouse habitat. The crew swept over a relatively large area removing smaller Juniper trees, with the objective of maintaining the existing condition of the area. Project work and data collection took place in October, 2023.

Treatment Specifications: All trees under 5 feet in height within the designated area were cut at the base (stump height not to exceed 6 inches). The trees were scattered to a height not to exceed 24 inches above ground level. All limbs and sprouts were removed from the stump to prevent stump spouting and regrowth.

Sampling Methods

Sampling methods and sample size. To achieve adequate sample size, staff from CPE utilized G*Power3.1 statistical software to conduct a priori power analysis. A total sample size of 80(40 treatment sites and 40 comparison sites) was determined to be sufficient. The program planned to sample at least 20 treatment and 20 comparison sites during each collection period. Data were collected at two time points, with 40 treatment and 40 comparison sites for a total of 80 samples (Table 1).

Table 1

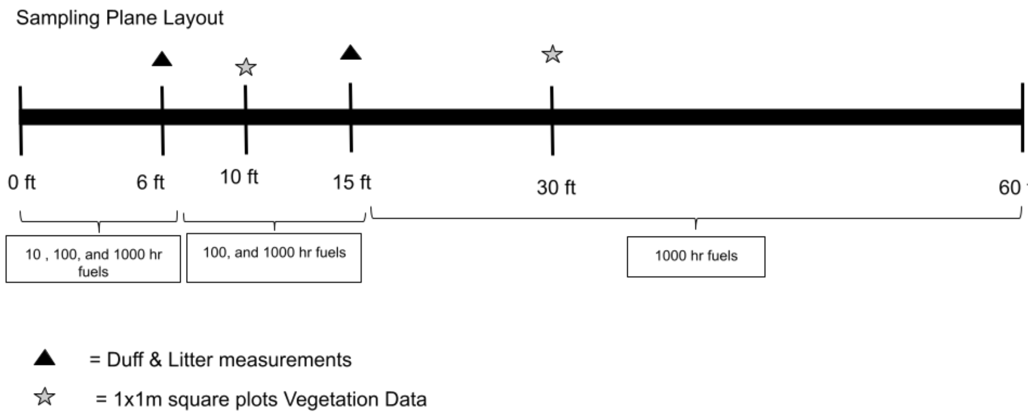
Number of treatment and comparison sites by sample year

Sample Year	Number of Treatment Sites	Number of Comparison Sites
2022	20	20
2023	20	20
Total	**40**	**40**

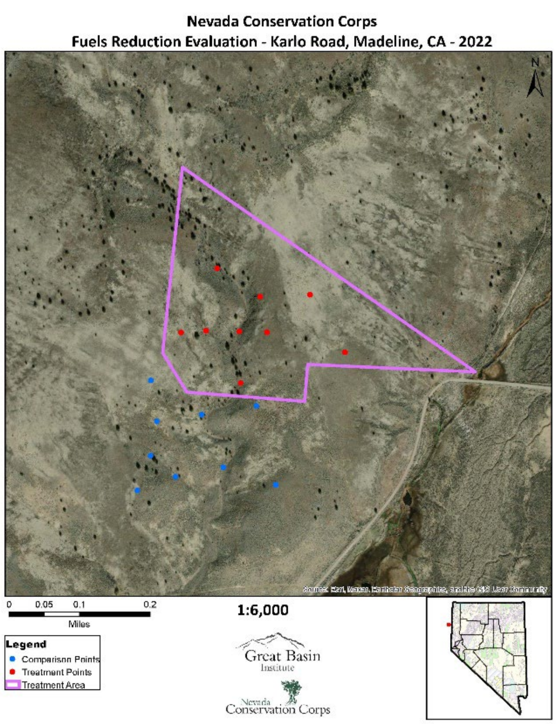
Fuel loading data was collected using Brown's planar intercept method. The planar intercept (or line transect) technique is used to sample dead and down woody debris in the 1-hour, 10-hour, 100-hour, and 1,000-hour and greater size classes. Litter and duff depths are measured at two points along the base of each sampling plane. Cover and height of live and dead, woody, and nonwoody vegetation is estimated at two points along each sampling plane.

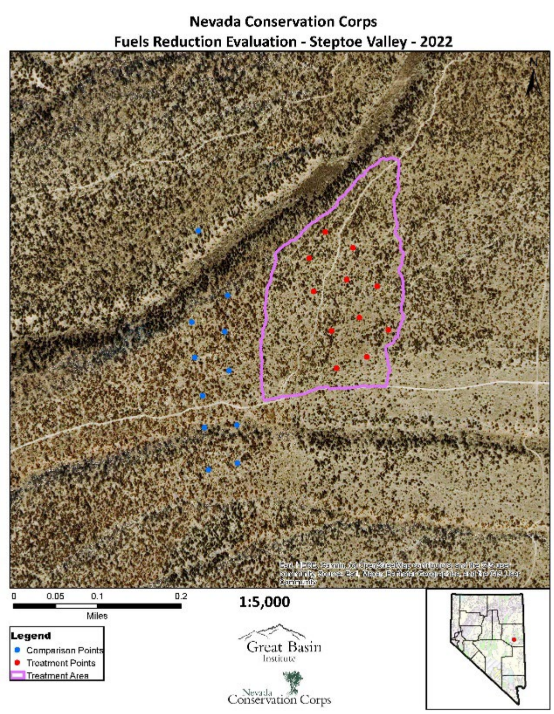
During Year 1 of the evaluation, NCC sampled a total of 20 points before and after treatment, in addition to 20 comparison points. Each sampling event included 3 transects radiating from the center of the subplot. A photo was taken of each transect, and the slope and azimuth were recorded.

Transects were 60 feet in length, and measurements were taken starting at the far end and working back towards the center point. 1-hour and 10-hour fuel intersects were counted along the first 6 feet of the transect. 100-hour fuel intersects were counted for the first 15 feet of the transect. 1,000-hour fuels were recorded for the entire length of the transect. Duff and litter were measured at 6 feet and 15 feet. Vegetation cover and heights were recorded at 10 feet and 30 feet. Figures 1 and 2 show the treatment and comparison sites for 2022 and Figures 3 and 4 show treatment and comparison sites for 2023.

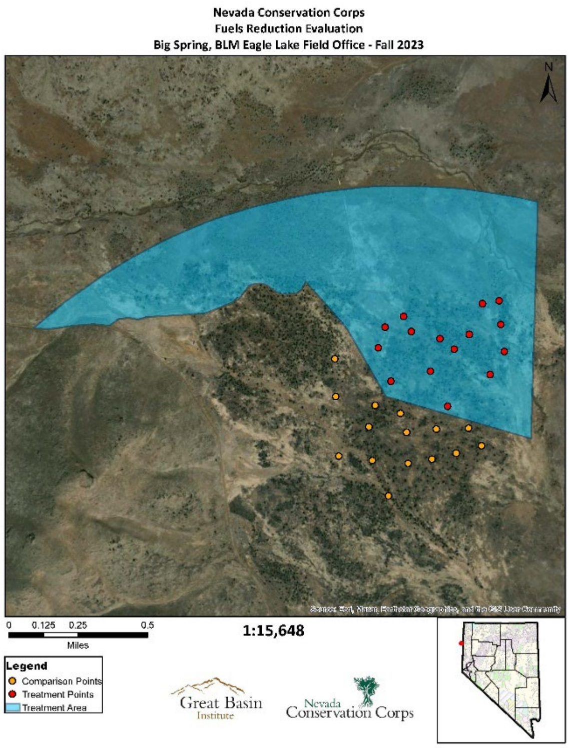


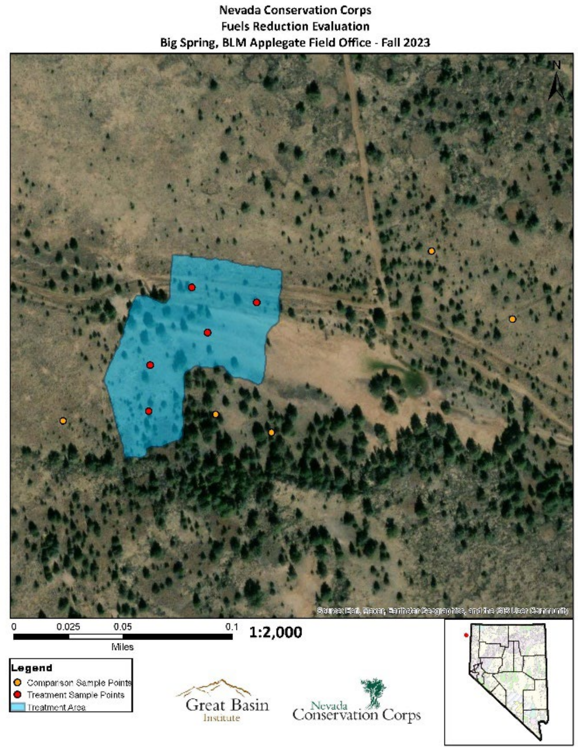
Figures 1 and 2. 2022 Fuel Load Treatment and Comparison Sample Sites





Figures 3 and 4. 2023 Fuel Load Treatment and Comparison Sample Sites





Statistical Analysis

A MANCOVA was planned to determine the effect of the treatment on 4 dependent variables: Downed Woody Debris Tons/Acre, Average Live Tree/Shrub Percent Cover and Average Tree/Shrub Height after controlling for pre-treatment levels of the variables. Analyses were conducted to check that the assumptions of the statistical test were met. Since the data did not meet the assumption of homogeneity of regression slopes, it was determined that MANCOVA could not be used. Assumptions were then checked for separate ANCOVA for each dependent variable, controlling for pre-treatment levels. Again, the assumption of homogeneity of regression slopes was not met for the ANCOVA tests for two of the dependent variables (Average Live Tree/Shrub Percent Cover and Average Tree/Shrub Height) as interaction terms were significant. ANCOVA was conducted for Downed Woody Debris Tons/Acre as the assumption of homogeneity of regression slopes was met.

As an alternative to MANCOVA and ANCOVA, which require homogeneity of regression slopes, the Johnson-Neyman technique was used to fit a regression model and identify the zone(s) of significance, i.e. levels of the pretest, where the two conditions differ significantly on the posttest (D’Alonzo, 2004; Ji, 2016). Analyses were conducted with SPSS 29. The Johnson-Neyman analyses were conducted with the PROCESS Procedure for SPSS Version 4.2 by Andrew F. Hayes.

Results: US Forest Service Analysis of Fuel Loading

2022 (Steptoe Valley, NV and Madeline, CA). Post treatment monitoring was conducted using Browns Planar Intercept Method. Based on a review of the descriptive statistics presented in the results (referenced tables) there was a small to moderate change in the fuel loading and fuel arrangement characteristics. Areas within the units for which there were higher tree densities had the greater increase in total fuel loading post treatment. This is expected because treatments methods primarily cut trees and activity fuel was re-arranged closer to the ground. In addition, it is important to point out the untreated comparison data in which the fuel loading in the project not receiving fuel treatment was higher in the Madeline area and lower in the Steptoe area. This may indicate higher variability of fuel loading within the areas and no difference in mean fuel loading pre and post treatment.

Both treatments included lop and scatter and thinning of mainly smaller sized regeneration and sapling sized trees. As a result of these treatments an increase in tree spacing was achieved and this reduced the continuity of ladder fuels across the areas. Both units had a reduction in total tree cover with total fuel loading increasing greater in the Steptoe unit and within the 1000 hours fuels only in the Madeline unit. The increased fuel loading at the Steptoe Valley unit came mainly from 10 and 100 hour fuels, and the Madeline unit showed a decrease in 10 and 100 hour fuels. Overall total DWD fuel loading post treatment remains less than 10 tons per acre (highest post treatment ~6.1 tons/ac – Steptoe Valley). Total fuel loading in Madeline maintains at less than 1 ton/ac total. This indicates that resistance to control (in the event of a wildfire) should not be a concern in a post treatment environment.

2023 (Rock Spring and Big Spring). Post treatment monitoring was conducted using Browns Planar Intercept Method. Based on a review of the descriptive statistics presented in the results (referenced tables) there was a small to moderate change in the fuel loading and fuel arrangement characteristics. Areas within units for which there were higher tree densities had the greater increase in total fuel loading. This is expected due to the treatments that were conducted in which lopping or cutting smaller conifers occurred. These smaller trees and ladder fuels were primarily removed and re-arranged closer to the ground.

The Rock Spring area included a combination of cut and pile as well as lop and scatter of all juniper trees of all sizes from seedling up to 24” diameter, excluding old growth, from the area within and surrounding a riparian exclosure. Smaller hand piles were also created outside of the exclosure with the intent to eventually burn those piles. The Big Spring area included removal of mainly smaller sized regeneration and sapling sized trees, therefore the treatment did not manipulate a large number of trees or high volume of vegetation. As a result, a minor increase in tree spacing was achieved and this only slightly reduced ladder fuels. Post treatment sampling indicates decreased average vegetation cover at Rock Spring. There was an increase in total fuel loading at both sites. The fuel loading at Big Spring increased slightly from 0.3 to 0.4 tons/acre, due mainly to a change in the 10 and 100 hour fuels. At Rock Spring, the total fuel loading increased from 0.8 tons/ac to 4.4 tons/ac, with the change coming mainly from 1,000 hour fuels.

This was representative of the size and density of vegetation/fuels that were cut at each location as part of the treatment that was re-arranged to the ground surface. Once hand piles are burned this fuel loading is expected to decrease. Finally, the overall total DWD fuel loading post treatment remains less than 10 tons per acre. This indicates that resistance to control (in the event of a wildfire) is not a major concern in a post treatment environment.

Based on a limited application of the pre and post treatment data (stand level) to assumptions across a larger landscape, some limited inference of effects to Fire Regime Condition Class can be made. This area and respective vegetation types can be grouped into low and mixed severity regime groups. The reduction of conifer vegetation density and re-arrangement of fuels as described above indicate a trend toward improvement of the fire regime condition class within the treatment area. It also indicates a trend towards conversion back to more historical woodland interface with sage brush and rangelands. This means that the treatments have maintained or slightly improved the condition class, partially moved the condition class from 3 (highly departed) to a 2 (moderately departed). Over time, +10 years, surface fuel loading post treatment may further decrease due to continued breakdown of the surface fuels, however conifer regeneration may occur which may require additional maintenance or other follow-up treatments. The entry into this project area with mechanical treatments does not substitute the benefits achieved with lower intensity fire. A prescribed fire or unplanned ignition in these areas could improve the trend of fire regime condition class (from 2 to 1 more resembling historic fire frequency/severity).

Results: Statistical Analyses

Downed Woody Debris Tons/Acre. A one-way ANCOVA was conducted to evaluate the effect of fuels reduction treatments on post-intervention Downed Woody Debris Tons/Acre (DWD) after controlling for pre-intervention DWD. After adjustment for pre-intervention downed woody debris tons/acre, there was not a statistically significant difference in post-intervention downed woody debris tons/acre between the treatment and comparison groups, $F(2, 77) = 3.384$, $p = .07$, partial $\eta 2 = .042$.

Table 1. Adjusted and Unadjusted Intervention Means and Variability for Post-Intervention Downed Woody Debris Tons/Acre with Pre-Intervention Downed Woody Debris Tons/Acre as a Covariate

		Unadjusted		*Adjusted*	
	N	*M*	*SD*	*M*	*SE*
Comparison	40	1.05	1.34	1.37	.43
Treatment	40	2.79	4.89	2.48	.43

Note: N = number of plots, M = Mean, SD = Standard Deviation, SE = Standard Error

Average Live Tree/Shrub Percent Cover. A multiple regression analysis was conducted with post-intervention Average Live Tree/Shrub Percent Cover as the dependent variable and treatment condition, pre-intervention Average Live Tree/Shrub Percent Cover, and the interaction term condition* Average Live Tree/Shrub Percent Cover as predictor variables. The overall model was significant, R^2 = .93, F(3, 76) = 328.92, p < .001. The interaction variable of condition* Average Live Tree/Shrub Percent Cover was significant (Table 2). Post Average Live Tree/Shrub Percent Cover was significantly related to treatment condition and pre-intervention. Post Average Live Tree/Shrub Percent Cover significantly moderated that relationship.

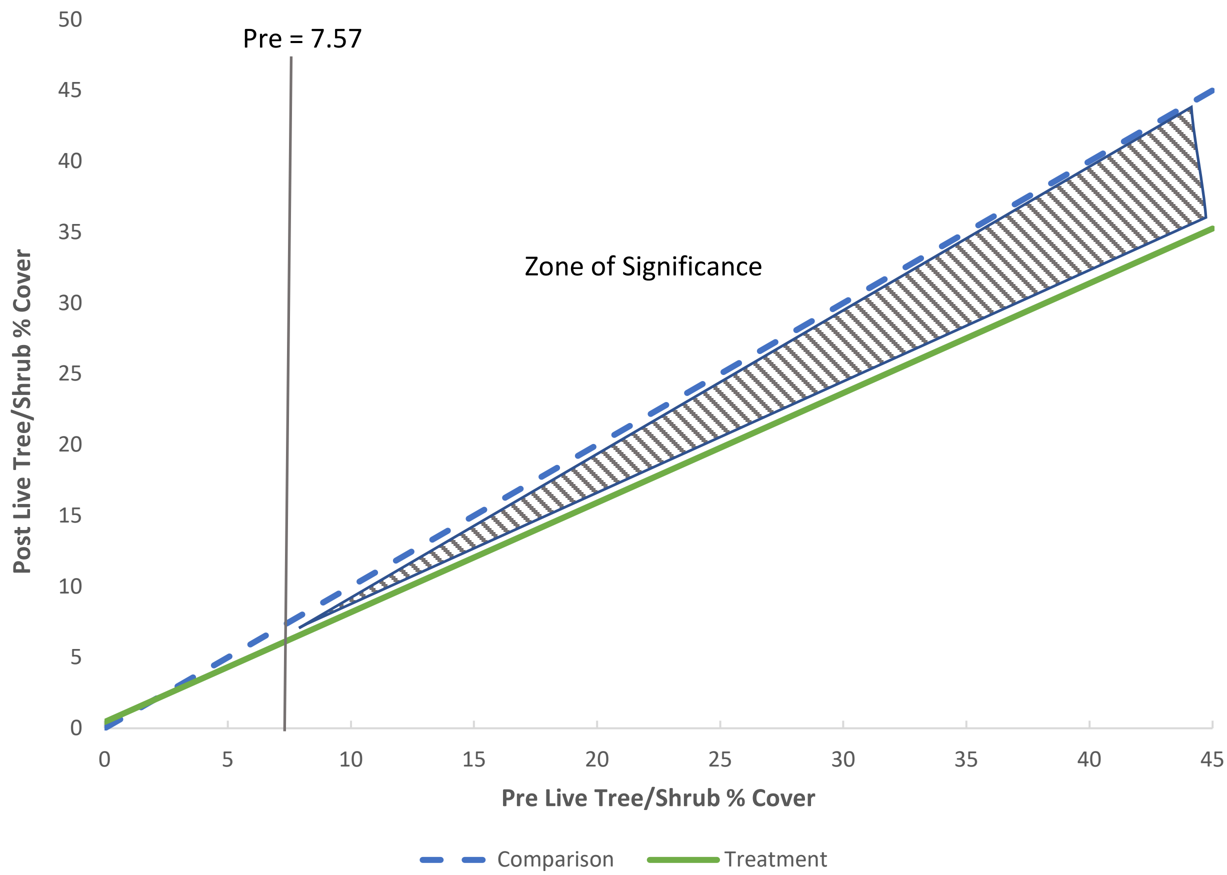
The Johnson-Neyman analysis technique was used to probe the significant interaction effect to identify at what Average Live Tree/Shrub Percent Cover pre-intervention levels did post Average Live Tree/Shrub Percent Cover differ by treatment condition. The analysis revealed a zone of significance for pre-intervention Average Live Tree/Shrub Percent Cover above 7.57 inches. Comparison and treatment groups were significantly different with respect to post- Average Live Tree/Shrub Percent Cover when pre Average Live Tree/Shrub Percent Cover was above 7.57 inches. In contrast, when pre Average Live Tree/Shrub Percent Cover was less than 7.57, the two groups did not differ on post Average Live Tree/Shrub Percent Cover (Figure 5).

Table 2. Regression of Associations between Post-Intervention Average Live Tree/Shrub Percent Cover, Treatment Condition, and Pre-Intervention Average Live Tree/Shrub Percent Cover

Variable	B	*SE*	*t*	*p*	*95% CI*	
					LL	*UL*
Constant	.00	.61	.00	1.00	-1.2207	1.2207
Condition	.45	.92	.49	.63	-1.3802	2.2760
Pre-ALTS	1.00	.04	27.28	.00	.9270	1.0730
Condition*Pre-ALTS	-.23	.07	-3.43	.001	-.3581	-.0949

Note. R^2= *.93 Pre-*ALTS *= Pre-Intervention average live tree/shrub percent cover; B = unstandardized regression coefficient; SE = standard error of the coefficient; CI = confidence interval; LL = lower limit; UL = upper limit;*

Figure 5. Johnson-Neyman Plot of Post Average Live Tree/Shrub Percent Cover



Average Tree/Shrub Height (ft). A multiple regression analysis was conducted with post-intervention Average Tree/Shrub Height in feet as the dependent variable and treatment condition, pre-intervention Average Tree/Shrub Height, and the interaction term condition* Average Tree/Shrub Height as predictor variables. The overall model was significant, R^2 = .94, F(3, 76) = 409.41, p < .001. The interaction variable of condition* Average Tree/Shrub Height was significant (Table 2). Post Average Tree/Shrub Height was significantly related to treatment condition and pre-intervention. Post Average Tree/Shrub Height significantly moderated that relationship.

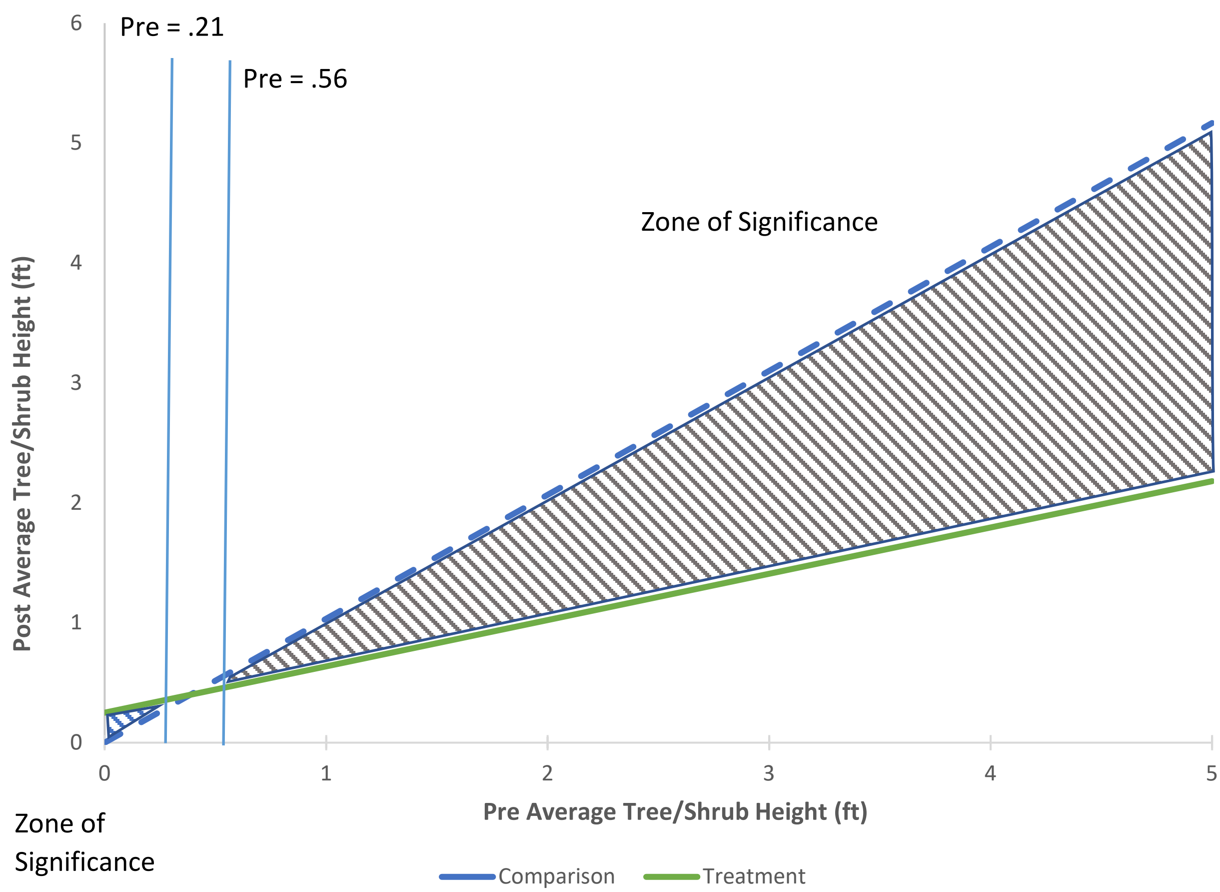
The Johnson-Neyman analysis technique was used to probe the significant interaction effect to identify at what Average Tree/Shrub Height pre-intervention levels did post Average Tree/Shrub Height differ by treatment condition. The analysis revealed two zones of significance for pre-intervention Average Tree/Shrub Height—below .21 feet and above .56 feet. Comparison and treatment groups were significantly different with respect to post- Average Tree/Shrub Height when pre Average Tree/Shrub Height was below .21 feet or above .56 feet. In contrast, when pre Average Tree/Shrub Height was greater than .21 feet and less than .56 feet, the two groups did not differ on post Average Tree/Shrub Height (Figure 5).

Table 3. Regression of Associations between Post-Intervention Average Tree/Shrub Height, Treatment Condition, and Pre-Intervention Average Tree/Shrub Height

Variable	B	*SE*	*t*	*p*	*95% CI*	
					LL	*UL*
Constant	.00	.04	.00	1.00	-.0884	.0884
Condition	.25	.07	3.54	.001	.1093	.3911
Pre-ATSH	1.00	.03	32.99	.000	.9396	1.0604
Condition*Pre-ATSH	-.6264	.07	-8.95	.000	-.7658	-.4870

Note. R^2*= .94 Pre-*ATSH *= Pre-Intervention average tree/shrub height in feet; B = unstandardized regression coefficient; SE = standard error of the coefficient; CI = confidence interval; LL = lower limit; UL = upper limit;*

Figure 6. Johnson-Neyman Plot of Post Average Tree/Shrub Height



Conclusion

The results of the quasi-experimental evaluation study demonstrated that NCC fuels reduction treatments had an impact on decreasing fuel load as measured by average live tree/shrub percent coverage and average tree/shrub height in feet compared to similar sites where fuels were not treated. The fuels reduction treatments undertaken in the study did not have an impact on decreasing fuel load as measured by Downed Woody Debris Tons/Acre. However, as the fuels reduction treatment projects in 2022 and 2023 focused on thinning sagebrush and cutting pinyon pine and juniper trees, these results align with the types of projects undertaken. Forest Service analysis indicated that one could infer that the fuel load reduction treatment moved the Fire Regime Condition Class from 3 (highly departed) to a 2 (moderately departed). The results of the evaluation study provide evidence of the success of NCC's efforts. We can conclude that NCC's fuel reduction program activities are indeed effective methods to achieve the program goals.

References

D'Alonzo, K.T. (2004). The Johnson-Neyman procedure as an alternative to ANCOVA. Western Journal of Nursing Research, 26(7), 804-812.

Ji, X.R. (2016). A primer on the Johnson-Neyman technique: An alternative procedure to ANCOVA. *General Linear Model Journal, 42(1), 25-31.*