Camp Blue Haven: Post-Wildfire Immediate Field Inventory Summary / November 2023
New Mexico Forest and Watershed Restoration Institute

Photo by Alex Makowicki

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Introduction and Project Description

The Southwest Ecological Restoration Institutes (SWERI) includes three university-based restoration institutes: the New Mexico Forest and Watershed Restoration Institute (NMFWRI), the Colorado Forest Restoration Institute (CFRI), and the Ecological Restoration Institute (ERI) in Arizona. These institutes work together to develop a program of applied research and service to help create healthy forests, prevent wildfires, sustain the resiliency of water supplies to wildfires, and create jobs. NMFWRI is located at Highlands University (HU) in Las Vegas, NM. According to the Southwest Forest Health and Wildfire Prevention Act (P.L. 108-317), the authorizing legislation for the SWERI, the purpose of the institutes is to "promote the use of adaptive ecosystem management to reduce the risk of wildfires and restore the health of forest and woodland ecosystems in the Interior West." NMFWRI has partnered with the United States Forest Service (USFS) and other agencies to monitor more than 2,350 plots on Collaborative Forest Restoration Program (CFRP) and other restoration projects across the state since 2007. The FWRI's Ecological Monitoring Program maintains a professionally managed field crew to collect data on short and long-term ecosystem responses to restoration treatments.

This data provides a critical scientific basis for adaptive management decisions and improved treatment effectiveness. The field crew also provides hands-on internship and training opportunities for students and recent graduates to help build New Mexico's forestry workforce.

During August 2008 and September 2022, NMFWRI inventory and monitoring crew measured 6 plots across approximately 25 acres in Mineral Hill area of the Tecolote Creek Watershed. This project is accessible by Forest Road 637 off County Rd A16C off of NM Highway 283 in San Miguel County, New Mexico. The site is predominantly ponderosa pine but includes oak species and is at 7200 ft elevation with gentle slopes averaging 10%.   Unforested retention basins are present in the northwest part of the project; plots were not installed in this area.

The planned project involved a prescription to thin the stand to a residual basal area of 60 sqft/acre or less, creating a clumpy and uneven aged stand. Slash was planned to be chipped or lopped and scattered. Repeat monitoring photographs and treatment database records indicate that the proposed thinning project was not initiated at the plots monitored. See Treatment Prescription in Supplementary Information for more information.

In spring 2022, all plots were burned in the Hermit's Peak Calf Canyon (HPCC) wildfire at low to moderate composite burn severity. The Hermit's Peak fire began as an escaped prescribed burn and later merged with the Calf Canyon fire which started as a winter pile burn. The Hermit's Peak Calf Canyon fire grew to become the largest and most destructive wildfire in New Mexico history at 341,471 acres. Of this footprint, 24% was classified as high soil burn severity, 30% was classified as moderate soil burn severity, 37% was classified as low soil burn severity, and 9% was classified as unburned. More information about the HPCC wildfire is available here: https://storymaps.arcgis.com/stories/d48e2171175f4aa4b5613c2d11875653

Monitoring Methods

The NMFWRI crew followed the protocols linked here: https://nmfwri.org/wp-content/uploads/2020/07/NMFWRI_Forest_Monitoring_Protocols-1.pdf which are based on the

Department of Interior's FEAT/FIREMON Integrated (FFI) sampling protocols. They used 1/10th acre fixed plots to assess tree size (diameter and height) and density (trees/acre). A nested sub-plot of 1/100th acre was used to estimate understory and ground cover in all years. Photo points were taken at each plot. Surface fuels were measured using Brown's transects in 2022. The location of the plots was based on a stratified random sampling design.

For more information regarding monitoring criteria and methodology please contact NMFWRI or consult the 2008 document authored by Derr, et. al., *Monitoring the Long Term Ecological Impacts Of New Mexico's Collaborative Forest Restoration Program, New Mexico Forest Restoration Series Working Paper 5*, available on NMFWRI's website here: http://nmfwri.org/collaborative-forest-restoration-program/cfrp-long-term-monitoring.

All raw data and photo points will be provided to the managers of the project area; the goal of this report is to summarize this information in a concise manner.

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 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.

Summary

Data Summary

The field crew observed a mixture of burn severities across measured plots in this project unit. Ponderosa pine remains the dominant growing stock species across both measurements, with a slight increase in the dominance of Gambel oak measured immediately post-wildfire in 2022. Tree health concerns include fire damage and mistletoe.

In general, growing stock basal area and density decreased following wildfire, in combination with an increase in quadratic mean diameter. Growing stock mean height and live crown base height also increased. A substantial increase in mean snag basal area, density, and quadratic mean diameter was noted, which can be largely attributed to mortality from fire.

Tree seedling density increased slightly from the pre-treatment to immediately post-wildfire measurements, but gains were entirely in oak species, with all conifer seedlings recorded as dead. Only dead Gambel oak saplings were recorded immediately post-wildfire, and no shrubs were detected. Ground cover data shows high levels of bare soil, litter, and plant basal coverage post-wildfire. Graminoids provided the highest aerial coverage immediately post-wildfire. Tree canopy values remained stable from pre-treatment to immediately post-wildfire, at around 52%.

A lack of pre-treatment surface fuel and ladder fuel data make trends for these metrics unavailable. Fuel loads measured immediately post-wildfire were dominated by litter and fine fuels, with no thousand-hour fuels detected across the project. Ladder fuel loads were highest for standing live fuels by biomass, but herbaceous live fuels had the highest mean percent cover.

Management Implications

Although a portion of this project burned at moderate severity and experienced relatively high tree mortality, the majority of the project maintained an intact live overstory. The relatively low overall burn severity and patchwork-style burn patterns observed mimics historical reference fire patterns and reduces concerns of natural conifer regeneration post-wildfire. It is likely that some areas of this project may transition to small meadows or oak scrubland patches, but the data do not indicate any imminent risk for a larger state-transition.

While the wildfire reduced growing stock density and basal area, these losses largely transferred to increases in snag density and basal area. Notably, total basal area (growing stock + snag) remained at 77 sqft/acre both pre-treatment and immediately post-wildfire. Total tree density (growing stock + snag) decreased by around 1/3 immediately post-wildfire but remains at 205 trees/acre. The shift of live trees to snags may increase the vulnerability of this project area to uncharacteristic wildfire in the future by increasing available fuels. While it can be assumed that the wildfire played a role in decreasing surface fuel loads, an increase in snag density and basal area will likely lead to an increase in surface fuels in the future as snags degrade and fall. Completing treatments such as those initially planned for this area would decrease the vulnerability of this project area to future high-severity fires. Further monitoring is needed to determine adaptive management strategies as the post-wildfire ecosystem develops.

Table 1. Summary table: Camp Blue Haven. Species dominance is based on numeric density.

	Average (if applicable)	
	2008 Pre-treatment	**2022 Post-wildfire immediate**
Dominant tree	ponderosa pine	ponderosa pine
Dominant seedling	Gambel oak	Gambel oak
Dominant sapling	--	--
Dominant shrub (seedling class)	--	--
Dominant shrub (sapling class)	--	--
Dominant snag	Gambel oak	pine species
Dominant sick tree	ponderosa pine	ponderosa pine
Dominant aspect	N	N
Trees per acre (growing stock)	310	130
Basal area (growing stock, ft^2/acre)	77	57
QMD (inches, growing stock)	6.89	8.94
Average tree height (ft)	25	35
Height of tallest tree (ft)	56	52
Average LiCrBHt (ft)	11	21
Seedlings per acre	9000	10000
Saplings per acre	0	0
Shrub seedlings per acre	0	0
Tree canopy cover (%)	52	52
Grass & Forb cover (%)	47	30
Total tons surface fuels per acre	--	1.4

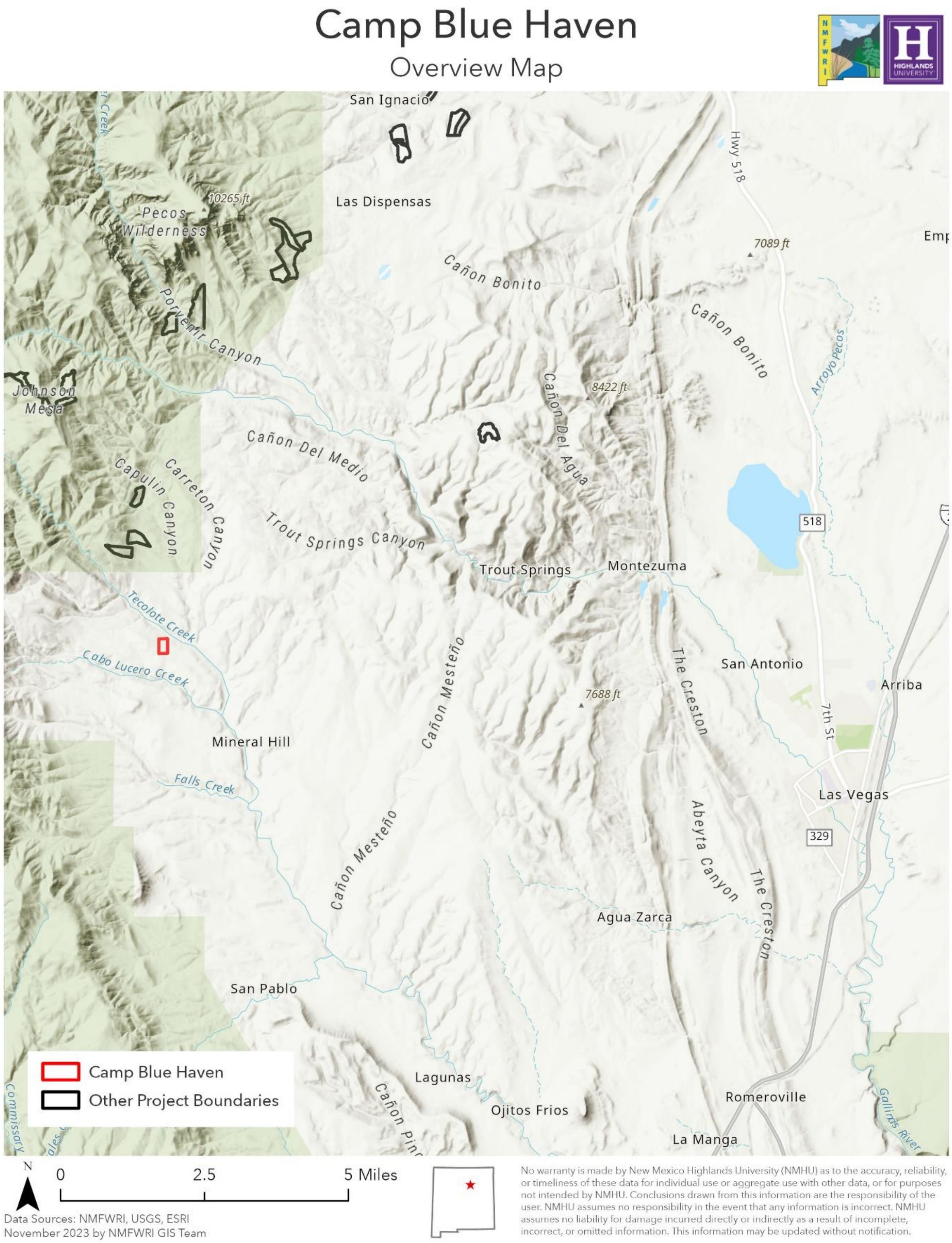

Figure 1. *Overview map of Camp Blue Haven project area.*

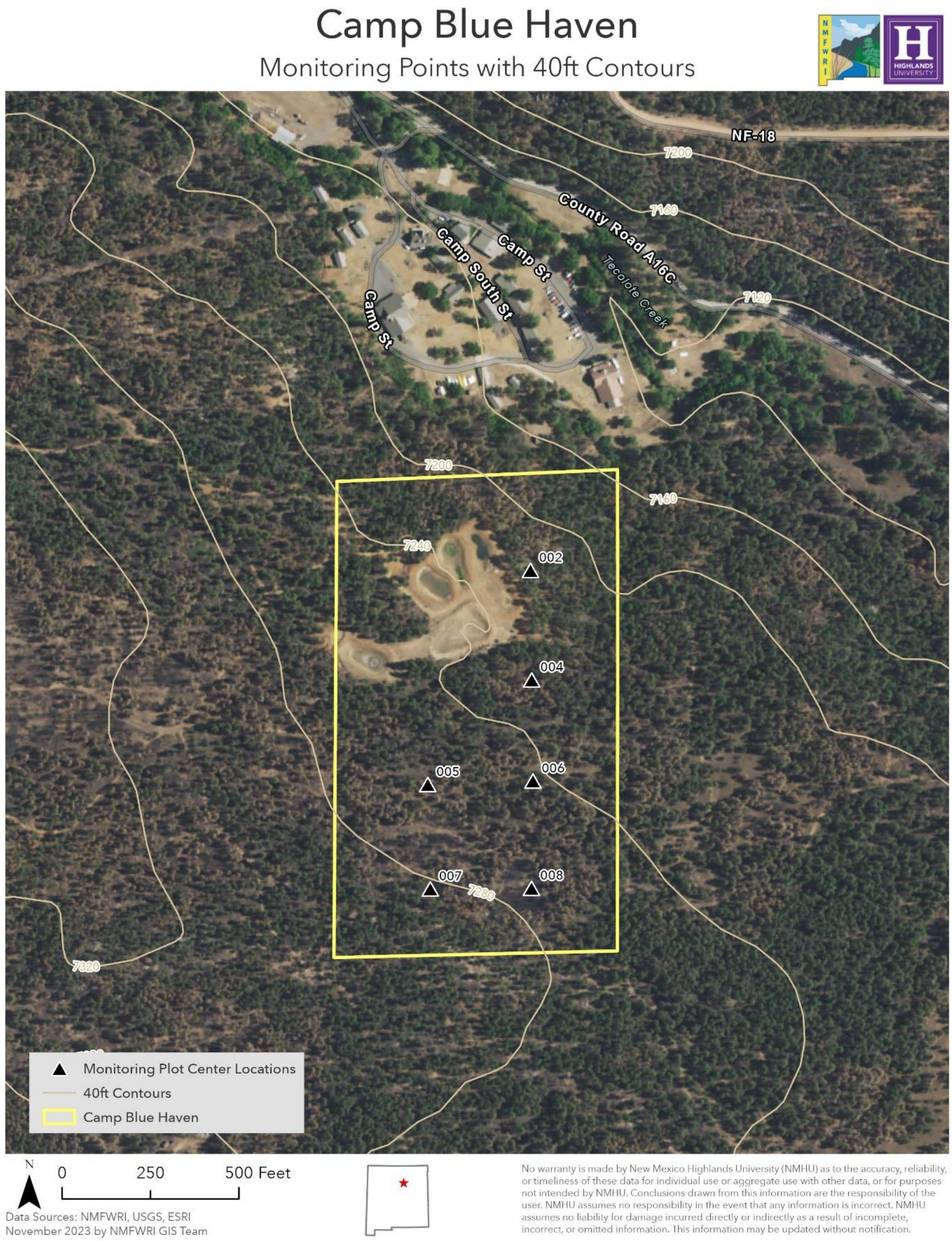

Figure 2*. Camp Blue Haven project area and monitoring plot locations with satellite imagery and 40ft contour lines.*

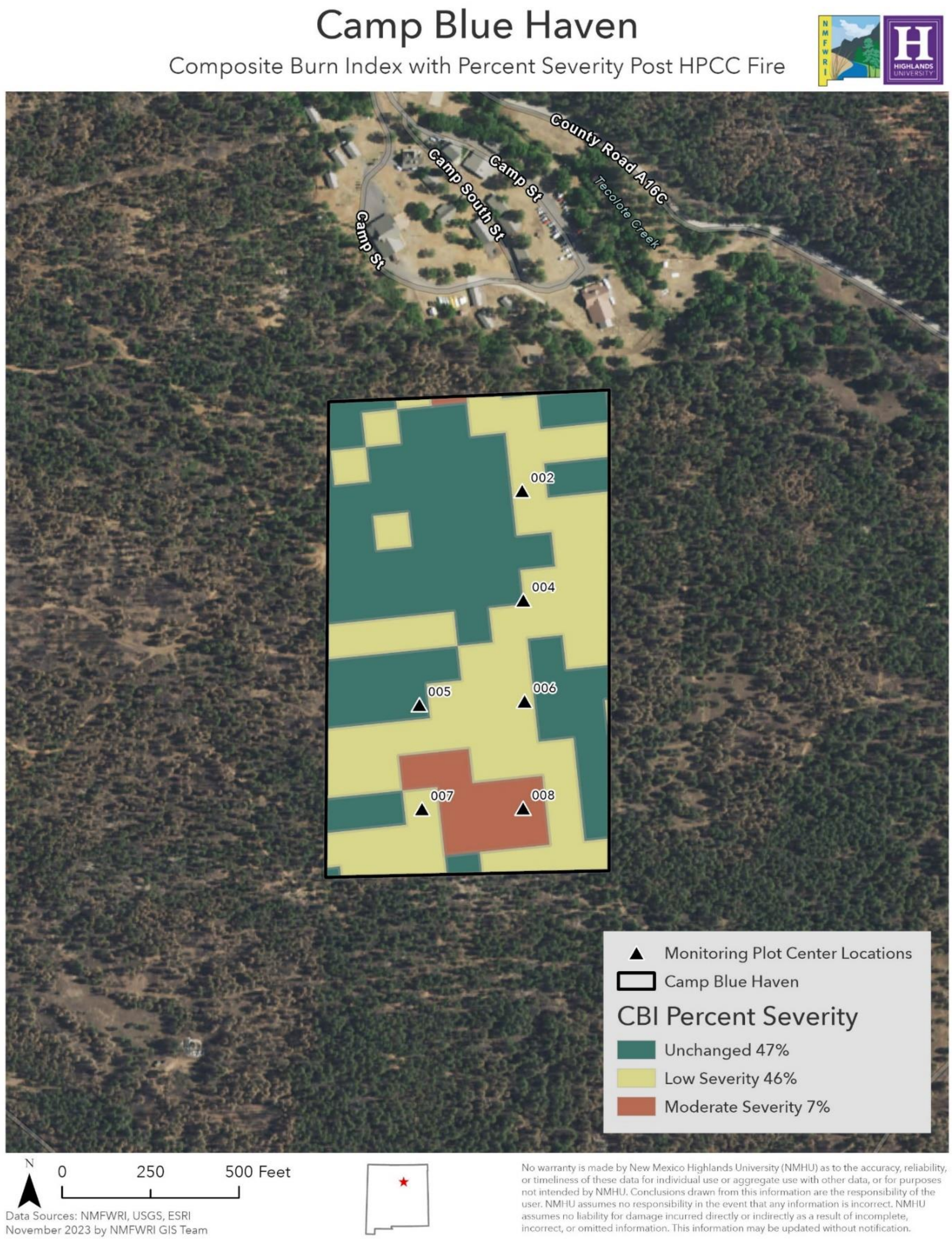

Figure 3. *Camp Blue Haven project area and monitoring plot locations with composite burn index layer. Total percentages of burn severity by category within the project boundary are listed in the legend.*

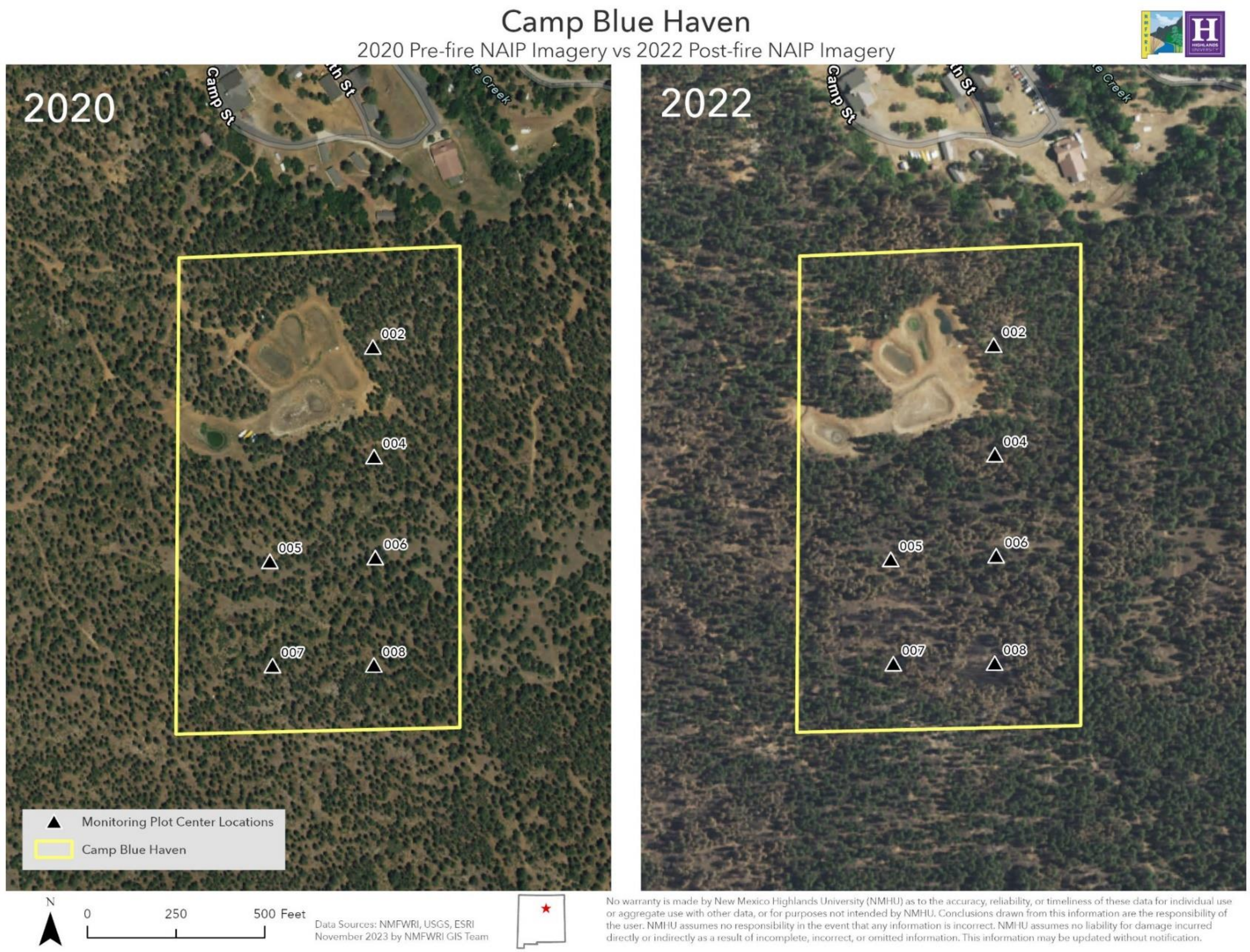

Figure 4. *Camp Blue Haven project area and monitoring plot locations with 2020 pre-fire and 2022 post-wildfire NAIP satellite imagery.*

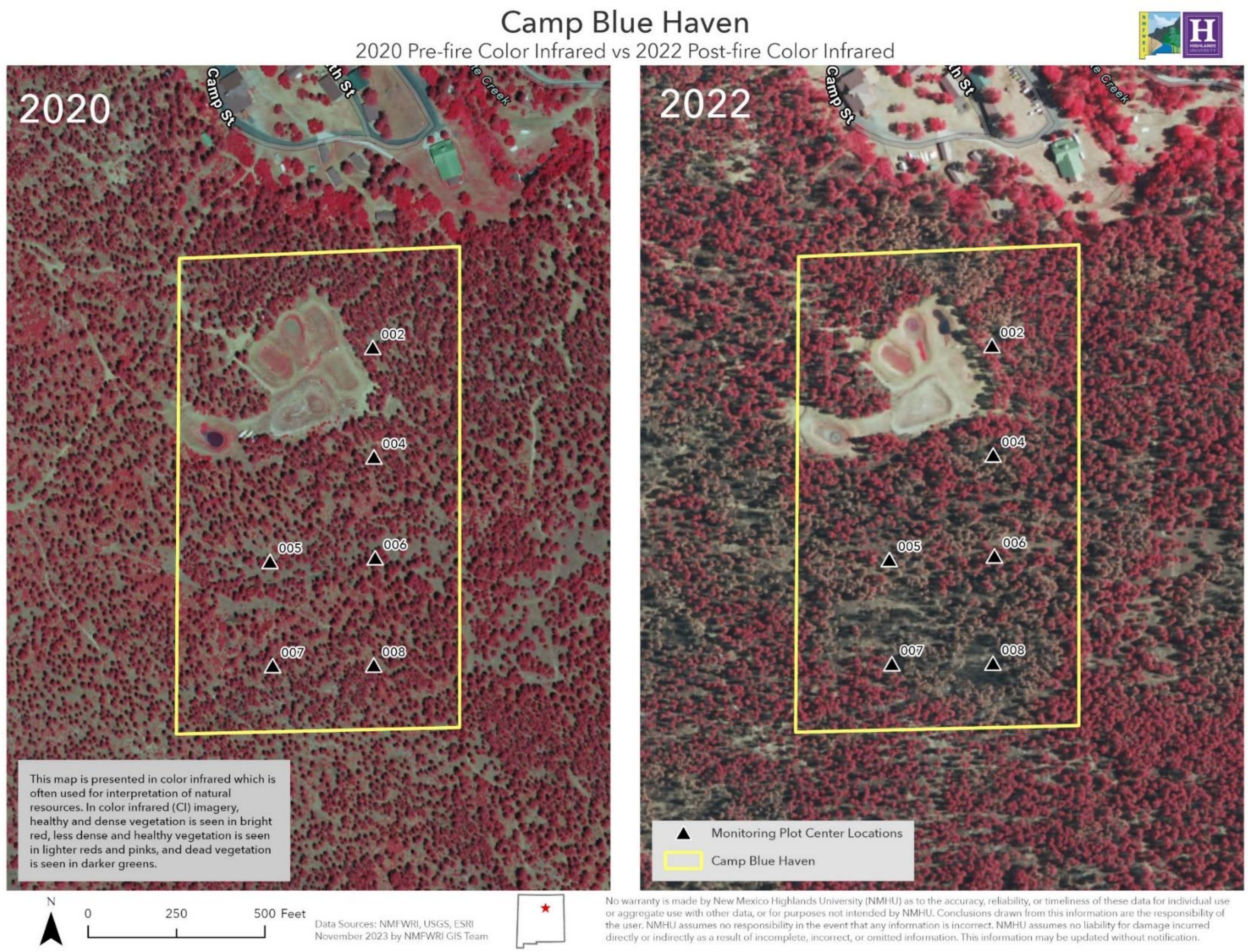

Figure 5. *Camp Blue Haven project area and monitoring plot locations with 2020 pre-fire and 2022 post-wildfire color infrared imagery.*

Tree Component

Overstory trees

Our results show that the overstory measured on plots was dominated by ponderosa pine across both monitoring statuses for growing stock trees, with a minor Gambel oak component. The snag overstory was dominated by Gambel oak pre-treatment and ponderosa pine immediately post-wildfire.

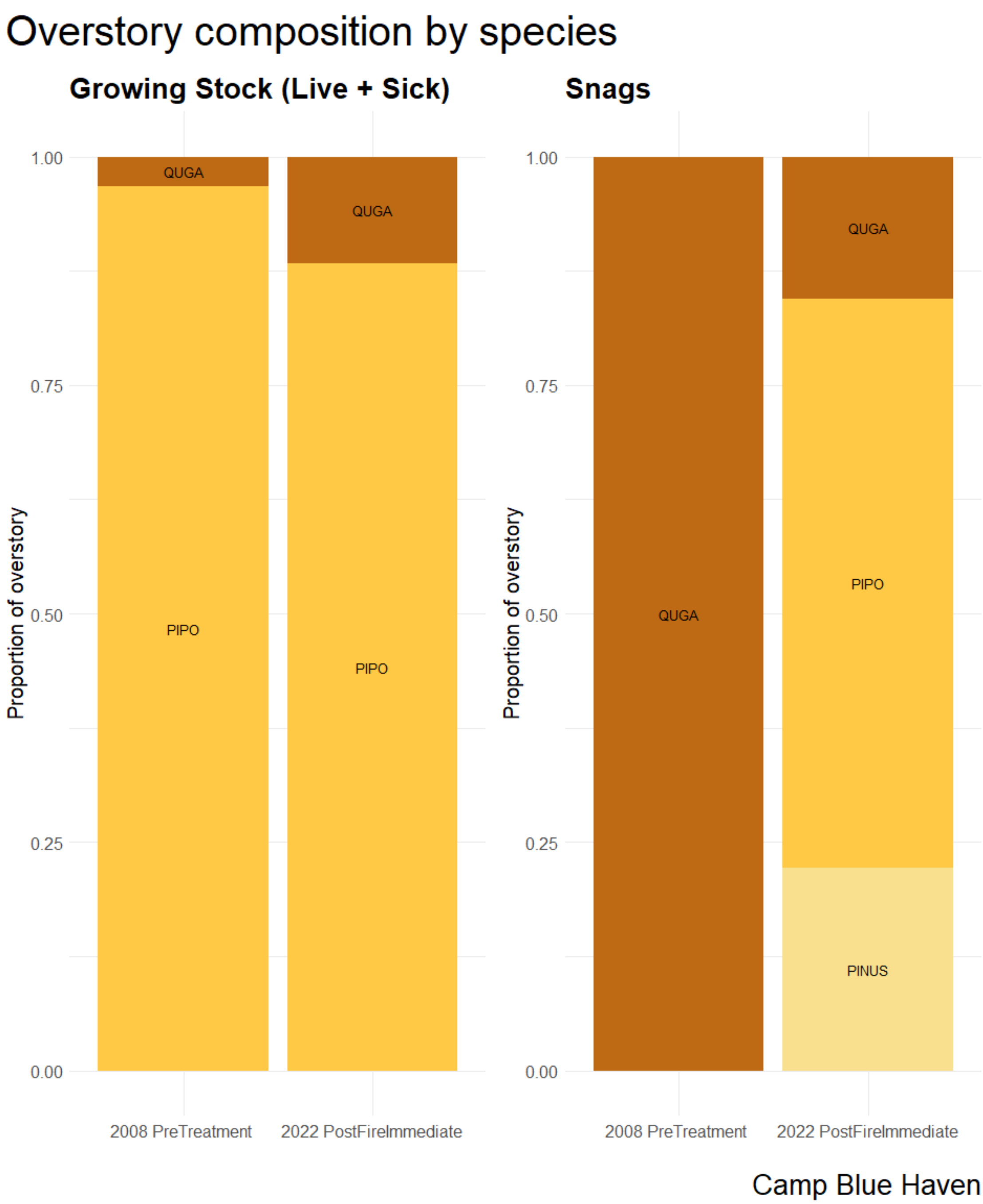

__Figure 6__. Species composition by status across all measurement periods for all trees (>1" DBH).

Species Symbol	Scientific Name	Common Name
PINUS*	*Pinus sp.*	pine species
PIPO	*Pinus ponderosa*	ponderosa pine
QUGA	*Quercus gambelii*	Gambel oak

*dead/burned and lacking identifying characteristics

Growing Stock

Growing stock mean height increased from 25 ft pre-treatment to 35 ft immediately post-wildfire, indicating the selective survival of taller trees or growth in the gap between monitoring. Likewise, mean live crown base height increased from 11 ft pre-treatment, to 21 ft immediately post-wildfire.

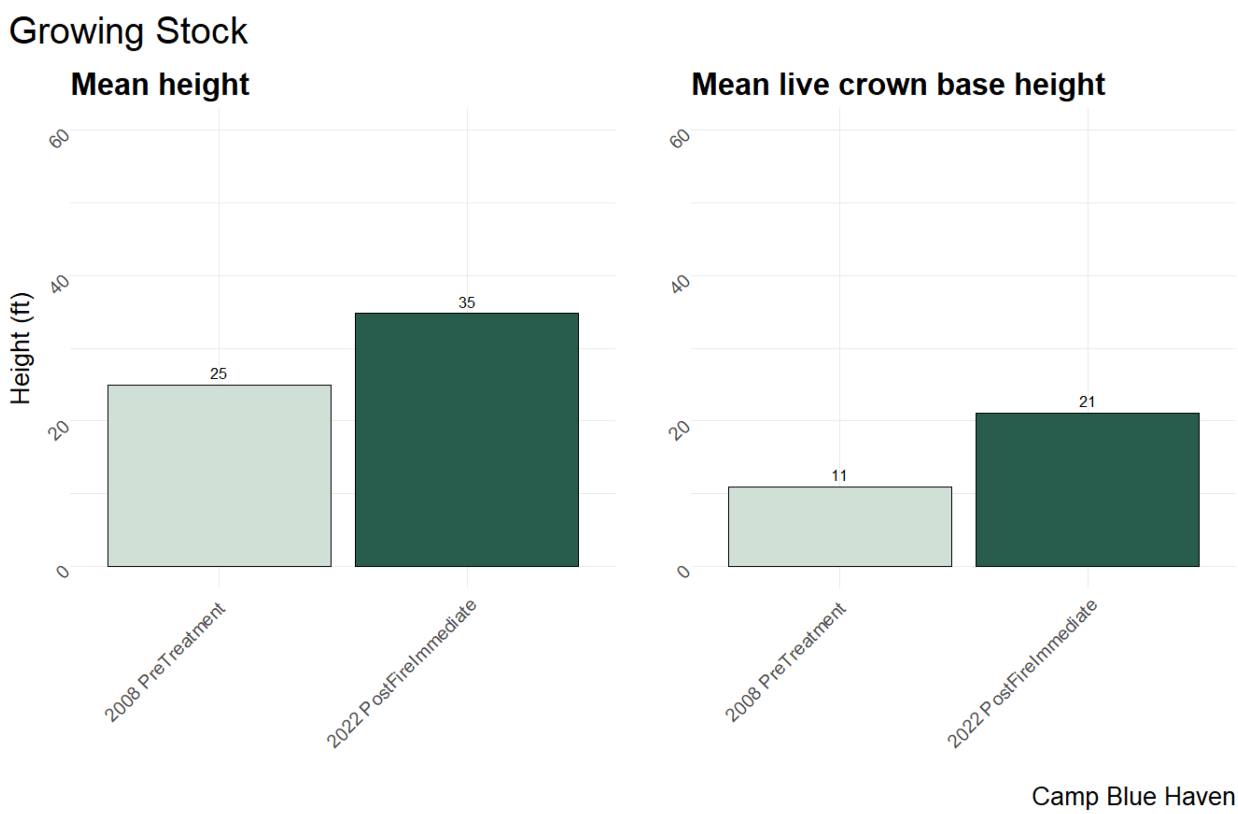

Figure 3. *Mean height and live crown base height for growing stock trees (>1" DBH, live + sick status).*

Growing stock mean basal area decreased from 77 sqft/acre pre-treatment to 57 sqft/acre immediately post-wildfire. Similarly, mean density decreased from 310 trees per acre pre-treatment to 130 trees per acre immediately post-wildfire. Quadratic mean diameter increased from 6.89 inches pre-treatment to 8.94 inches immediately post-wildfire.

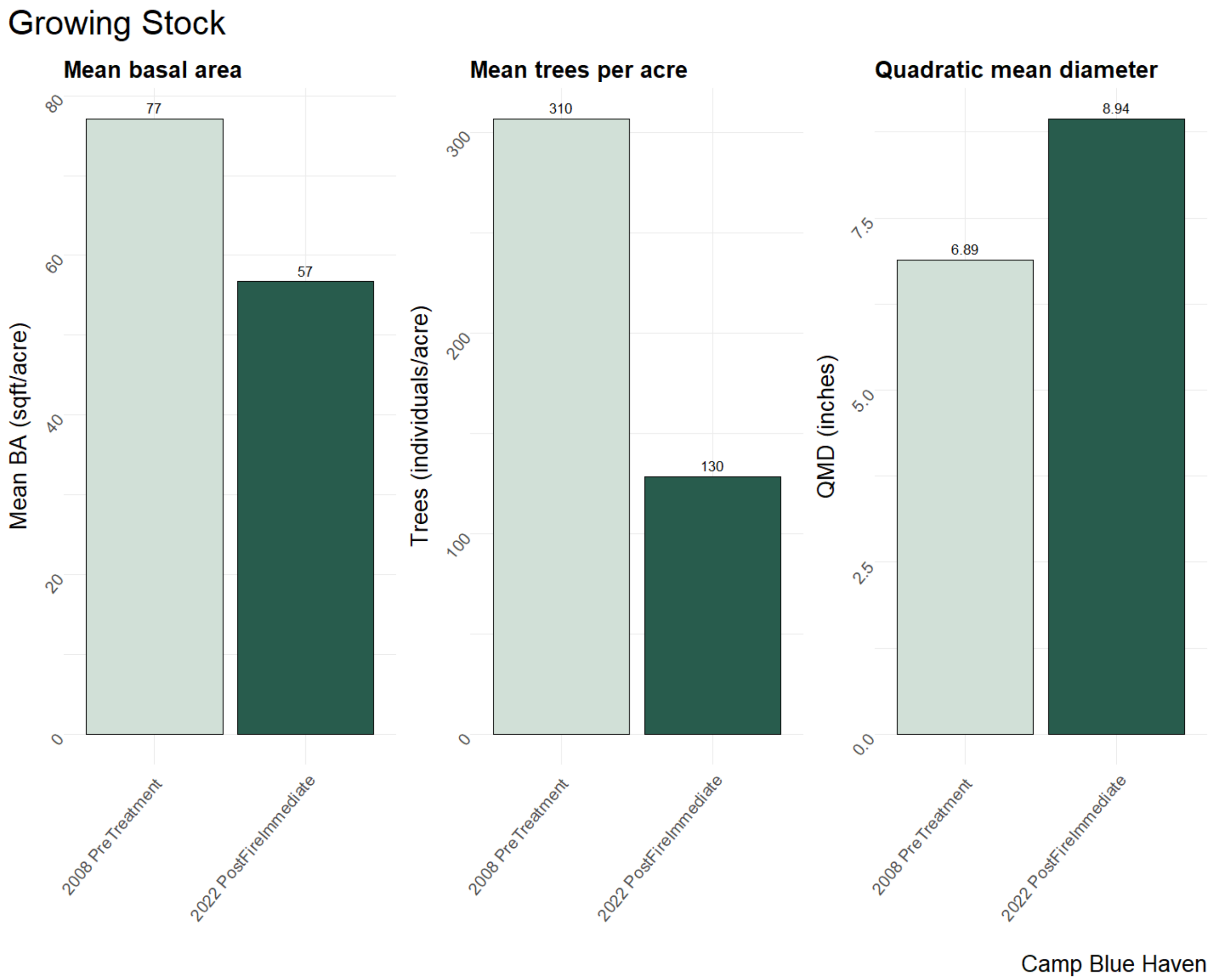

Figure 7. *Mean basal area, mean trees per acre, and quadratic mean diameter for growing stock trees across all measurement periods (>1" DBH, live + sick status).*

Snags

Snag mean basal area increased from 0.042 sqft/acre pre-treatment to 20 sqft/acre immediately post-wildfire. Likewise, mean snags per acre increased from 1.7 snags per acre to 75 snags per acre. Quadratic mean diameter for snags increased from 2.14 inches pre-treatment to 5.51 inches immediately post-wildfire. These trends are consistent with tree mortality by fire increasing snag counts across the project.

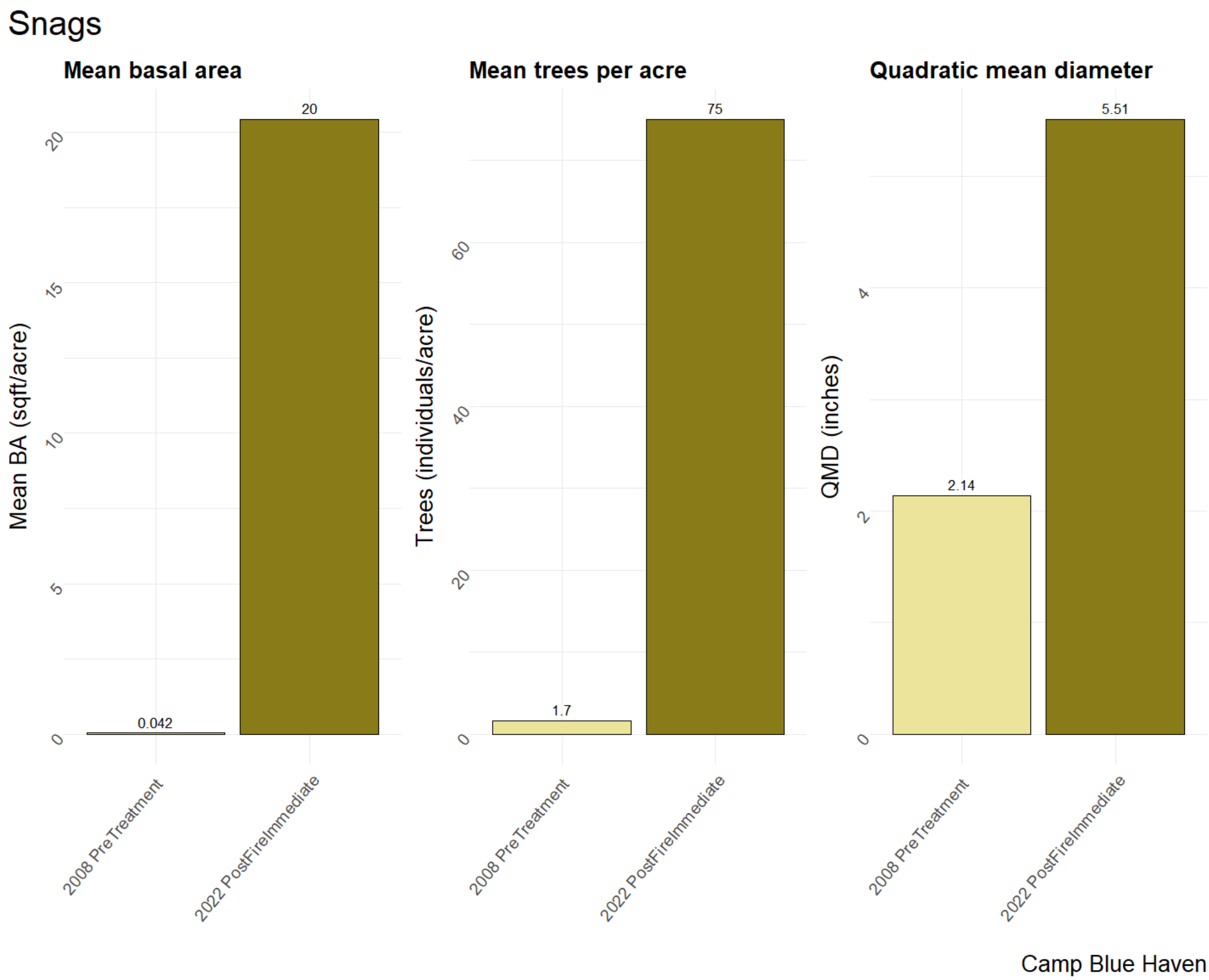

***Figure 8**. Mean basal area, mean trees per acre, and quadratic mean diameter for snags across all measurement periods (>1” DBH).*

In pre-treatment monitoring, mistletoe was the only damage noted, with 21 observations across the project. Immediately post-wildfire, one observation of mistletoe and 69 observations of fire damage were recorded. This trend could be explained by a reduction of mistletoe infection post-wildfire, documented by sources such as Conklin & Armstrong, 2005, or due to infected trees experiencing greater mortality in the fire.

Table 2. Table of damages observed on growing stock trees by monitoring status. Multiple damages may be recorded per individual tree.

Camp Blue Haven: Damage Observations for Growing Stock Trees

Monitoring Status	Damage Code	Count	Description
2008 PreTreatment	MISL	21	Mistletoe
2022 PostFireImmediate	BIRD	1	Bird/woodpecker damage
2022 PostFireImmediate	DTOP	2	Dead top
2022 PostFireImmediate	FIRE	69	Fire char and/or scorch
2022 PostFireImmediate	INSE	1	General insects
2022 PostFireImmediate	LEAN	1	Leaning bole
2022 PostFireImmediate	MISL	1	Mistletoe

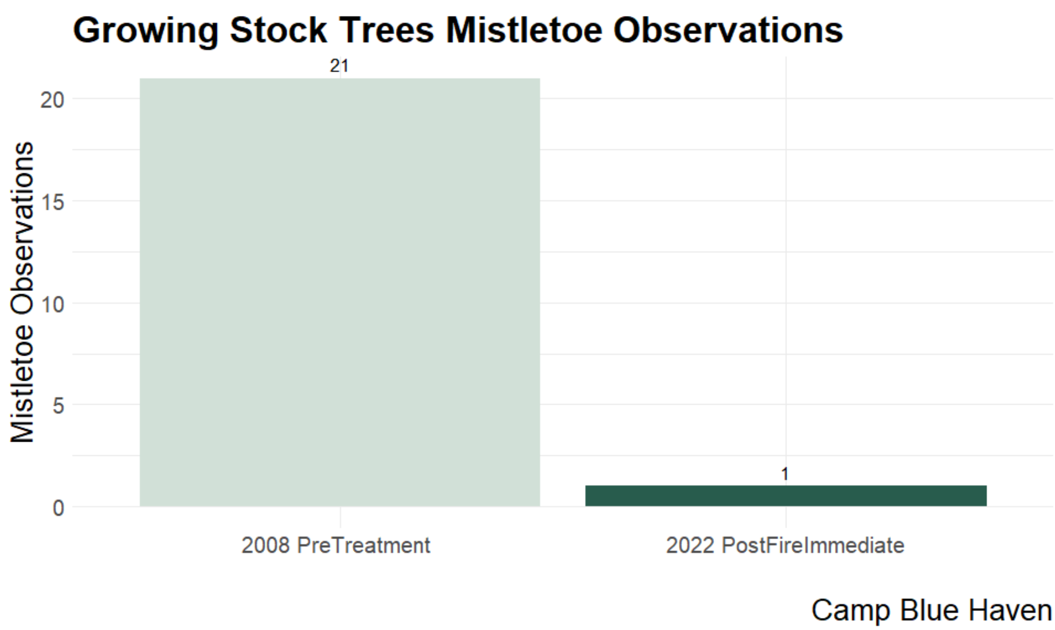

Figure 9. *Mistletoe observations on growing stock trees by monitoring status.*

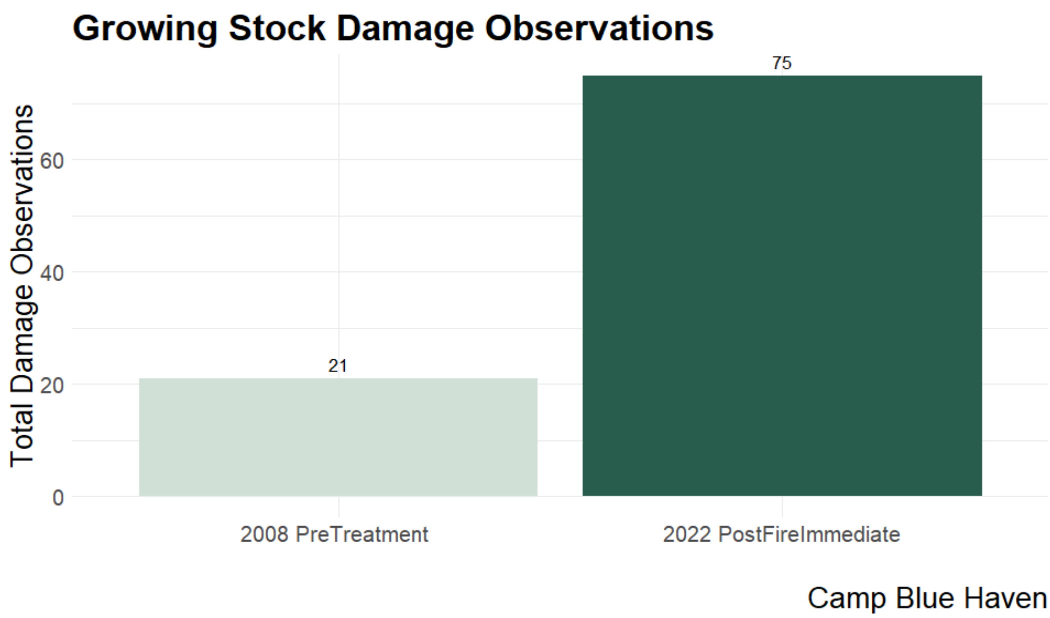

***Figure 10**. Damage observation count totals by monitoring status for growing stock trees. Multiple damages may be recorded per individual tree. Damage data collection by crew between monitoring statuses may affect observation totals.*

Camp Blue Haven: Damage Observations on Snags

***Table 2.** Table of damages observed on snags by monitoring status. Multiple damages may be recorded per individual snag.*

Monitoring Status	Damage Code	Count	Description
2022 PostFireImmediate	FIRE	45	Fire scorch and/or char

Stand Tables

Stand tables provide another way to visualize trees in an area. They represent the number of trees per acre in certain diameter classes and provide other summary values in a concise format.

Table 3. *Stand table of forestland species metrics for the 2008 pre-treatment measurement period.*

Stand Table		Camp Blue Haven August 2008																		
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+		
QUGA Gambel oak	COUNT	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.0	
	TPA	0.00	6.67	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10	3.3
	BA/AC	0.00	0.13	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.45
	AVE HT. (HL)	0.00	15	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Woodland Species Sub-total	COUNT	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.0	
	TPA	0.00	6.67	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10	3.3
	BA/AC	0.00	0.13	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.45
	AVE HT. (HL)	0.00	15	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Summary by Size Class for Woodland Species	TPA	10.00			0.00			0.00											10	
	TPA %	100.00%			0.00%			0.00%											100%	
	BA/AC	0.34			0.00			0.00											0.34	
	BA/AC %	100.00%			0.00%			0.00%											100%	
	QUADRATIC MEAN DIA.	2.51			0.00			0.00											2.5	
	AVE HT. (HL)	15			0.00			0.00											15	

Forestland Species		Saplings			Pole			Mature Trees											Total by Species & Covertype	%Species for all G-Stock
Diameter Class		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32		
PIPO Ponderosa pine	COUNT	0	39	35	27	40	26	8	1	2	0	0	0	0	0	0	0	0	180	
	TPA	0.00	65.00	58.33	45.00	66.67	43.33	13.33	1.67	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	300	97
	BA/AC	0.00	1.37	4.85	8.88	22.75	22.85	9.82	1.56	4.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	77	100
	AVE HT. (HL)	0.00	12.48	18.60	26.51	31.52	35.41	33.16	36.00	39.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Forestland Species Sub-total	COUNT	0	39	35	27	40	26	8	1	2	0	0	0	0	0	0	0	0	180	
	TPA	0.00	65.00	58.33	45.00	66.67	43.33	13.33	1.67	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	297	97
	BA/AC	0.00	1.37	4.85	8.88	22.75	22.85	9.82	1.56	4.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	77	100
	AVE HT. (HL)	0.00	12	19	27	32	35	33	36	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Summary by Size Class for Forestland Species	TPA	123.33			155.00			18.33											300	
	TPA %	41.57%			52.25%			6.18%											100%	
	BA/AC	6.22			54.48			16.07											77	
	BA/AC %	8.10%			70.97%			20.93%											100%	
	QUADRATIC MEAN DIA.	3.04			8.03			12.68											6.9	
	AVE HT. (HL)	17			32			35											32	

Stand Total		Saplings			Pole			Tree or Sawlog													Total by Class,Growing Stock & Dead	% by Class, Growing Stock vs Dead
Diameter Class		*0*	*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*	*22*	*24*	*26*	*28*	*30*	*32*		
Growing Stock (All living trees in woodland & forestland)	COUNT	0	43	37	27	40	26	8	1	2	0	0	0	0	0	0	0	0	*180*	
	TPA	0.00	71.67	61.67	45.00	66.67	43.33	13.33	1.67	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*310*	*99*
	BA/AC	0.00	1.50	5.06	8.88	22.75	22.85	9.82	1.56	4.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*77*	*100*
	AVE HT, HL	0.00	13	18	27	32	35	33	36	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Summary by Size Class (All living trees in woodland & forestland)	TPA	133.33			155.00			18.33											*310*	
	TPA %	43.48%			50.54%			5.98%											*100%*	
	BA/AC	6.56			54.48			16.07											*77*	
	BA/AC %	8.51%			70.65%			20.84%											*100%*	
	QMD MEAN DIA.	3.00			8.03			12.68											*6.8*	
	AVE HT, HL	17			32			35											*32*	
Dead (All dead trees in woodland & forestland)	COUNT	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	
	TPA	0.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*1.7*	*0.54*
	BA/AC	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.042*	*0.054*
	AVE HT, HL	0.00	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*7.0*	
Total for all sample trees including Growing Stock and Dead	COUNT	0	44	37	27	40	26	8	1	2	0	0	0	0	0	0	0	0	*190*	
	TPA	0.00	73.33	61.67	45.00	66.67	43.33	13.33	1.67	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*310*	*100*
	BA/AC	0.00	1.54	5.06	8.88	22.75	22.85	9.82	1.56	4.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*77*	*100*

*NOTE1: Average Diameter calculated using the Quadratic Mean Diameter (QDM), equivalent equation: (SQRT((BA/AC)/TPA) /.005454)) ; NOTE2: Average Height (HL), calculated using Lorey's height equation for a weighted mean, HL=SUM(bi * hi)/SUM(bi) , where bi is basal area of individual tree & hi is height of an individual tree.*

Table 4. Stand table of forestland species metrics for the 2022 post-wildfire immediate measurement period.

Stand Table		Camp Blue Haven					September 2022													
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+		
QUGA Gambel oak	COUNT	0	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.0	
	TPA	0.00	10.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15	12
	BA/AC	0.00	0.11	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.93
	AVE HT. (HL)	0.00	11	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Woodland Species Sub-total	*COUNT*	*0*	*6*	*3*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*9.0*	
	TPA	*0.00*	*10.00*	*5.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*15*	*12*
	BA/AC	*0.00*	*0.11*	*0.42*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.53*	*0.93*
	AVE HT. (HL)	*0.00*	*11*	*21*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*		
Summary by Size Class for Woodland Species	*TPA*		*15*			*0.00*							*0.00*						*15*	
	TPA %		*100.00%*			*0.00%*							*0.00%*						*100%*	
	BA/AC		*0.53*			*0.00*							*0.00*						*0.53*	
	BA/AC %		*100.00%*			*0.00%*							*0.00%*						*100%*	
	QUADRATIC MEAN DIA.		*2.54*			*0.00*							*0.00*						*2.5*	
	AVE HT. (HL)		*19*			*0.00*							*0.00*						*19*	

Forestland Species		Saplings			Pole			Mature Trees											Total by Species & Covertype	%Species for all G-Stock
Diameter Class		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32		
PIPO Ponderosa pine	COUNT	0	2	5	10	14	17	14	4	1	1	0	0	0	0	0	0	0	68	
	TPA	0.00	3.33	8.33	16.67	23.33	28.33	23.33	6.67	1.67	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	110	88
	BA/AC	0.00	0.04	0.76	3.18	8.73	14.18	17.27	6.90	2.47	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56	99
	AVE HT. (HL)	0.00	7.36	22.77	30.34	36.21	41.18	43.80	49.72	48.30	51.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Forestland Species Sub-total	*COUNT*	*0*	*2*	*5*	*10*	*14*	*17*	*14*	*4*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*68*	
	TPA	*0.00*	*3.33*	*8.33*	*16.67*	*23.33*	*28.33*	*23.33*	*6.67*	*1.67*	*1.67*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*110*	*88*
	BA/AC	*0.00*	*0.04*	*0.76*	*3.18*	*8.73*	*14.18*	*17.27*	*6.90*	*2.47*	*2.69*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*56*	*99*
	AVE HT. (HL)	*0.00*	*7*	*23*	*30*	*36*	*41*	*44*	*50*	*48*	*52*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*		
Summary by Size Class for Forestland Species	*TPA*		*12*			*68*							*33*						*110*	
	TPA %		*10*			*60*							*29*						*100%*	
	BA/AC		*0.80*			*26*							*29*						*56*	
	BA/AC %		*1.4*			*46*							*52*						*100%*	
	QUADRATIC MEAN DIA.		*3.54*			*8.37*							*12.7*						*9.5*	
	AVE HT. (HL)		*22*			*38*							*46*						*42*	

Stand Total		Saplings			Pole			Tree or Sawlog											Total by Class,Growing Stock & Dead	% by Class, Growing Stock vs Dead
Diameter Class		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32		
Growing Stock (All living trees in woodland & forestland)	COUNT	0	43	37	27	40	26	8	1	2	0	0	0	0	0	0	0	0	180	
	TPA	0.00	71.67	61.67	45.00	66.67	43.33	13.33	1.67	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	310	99
	BA/AC	0.00	1.50	5.06	8.88	22.75	22.85	9.82	1.56	4.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	77	100
	AVE HT, HL	0.00	13	18	27	32	35	33	36	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Summary by Size Class (All living trees in woodland & forestland)	TPA	133.33			155.00			18.33											310	
	TPA %	43.48%			50.54%			5.98%											100%	
	BA/AC	6.56			54.48			16.07											77	
	BA/AC %	8.51%			70.65%			20.84%											100%	
	QMD MEAN DIA.	3.00			8.03			12.68											6.8	
	AVE HT, HL	17			32			35											32	
Dead (All dead trees in woodland & forestland)	COUNT	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	TPA	0.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.7	0.54
	BA/AC	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.042	0.054
	AVE HT, HL	0.00	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.0	
Total for all sample trees including Growing Stock and Dead	COUNT	0	44	37	27	40	26	8	1	2	0	0	0	0	0	0	0	0	190	
	TPA	0.00	73.33	61.67	45.00	66.67	43.33	13.33	1.67	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	310	100
	BA/AC	0.00	1.54	5.06	8.88	22.75	22.85	9.82	1.56	4.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	77	100

*NOTE1: Average Diameter calculated using the Quadratic Mean Diameter (QDM), equivalent equation: (SQRT((BA/AC)/TPA) /.005454)) ; NOTE2: Average Height (HL), calculated using Lorey's height equation for a weighted mean, HL=SUM(bi * hi)/SUM(bi) , where bi is basal area of individual tree & hi is height of an individual tree.*

Seedlings, Saplings, & Shrubs

Live tree seedling density increased slightly from 1500 individuals/acre pre-treatment to 1680 individuals/acre immediately post-wildfire. Dead seedlings were not recorded pre-treatment and were measured at 850 individuals/acre immediately post-wildfire. Live and dead shrubs of seedling stature were not recorded pre-treatment and were measured at 0 individuals/acre immediately post-wildfire.

No sapling data was recorded pre-treatment. Immediately post-wildfire, live tree sapling density was measured at 0 individuals/acre and dead tree sapling density was measured at 183 individuals/acre. Live and dead shrubs of sapling stature were both measured at 0 individuals/acre immediately post-wildfire.

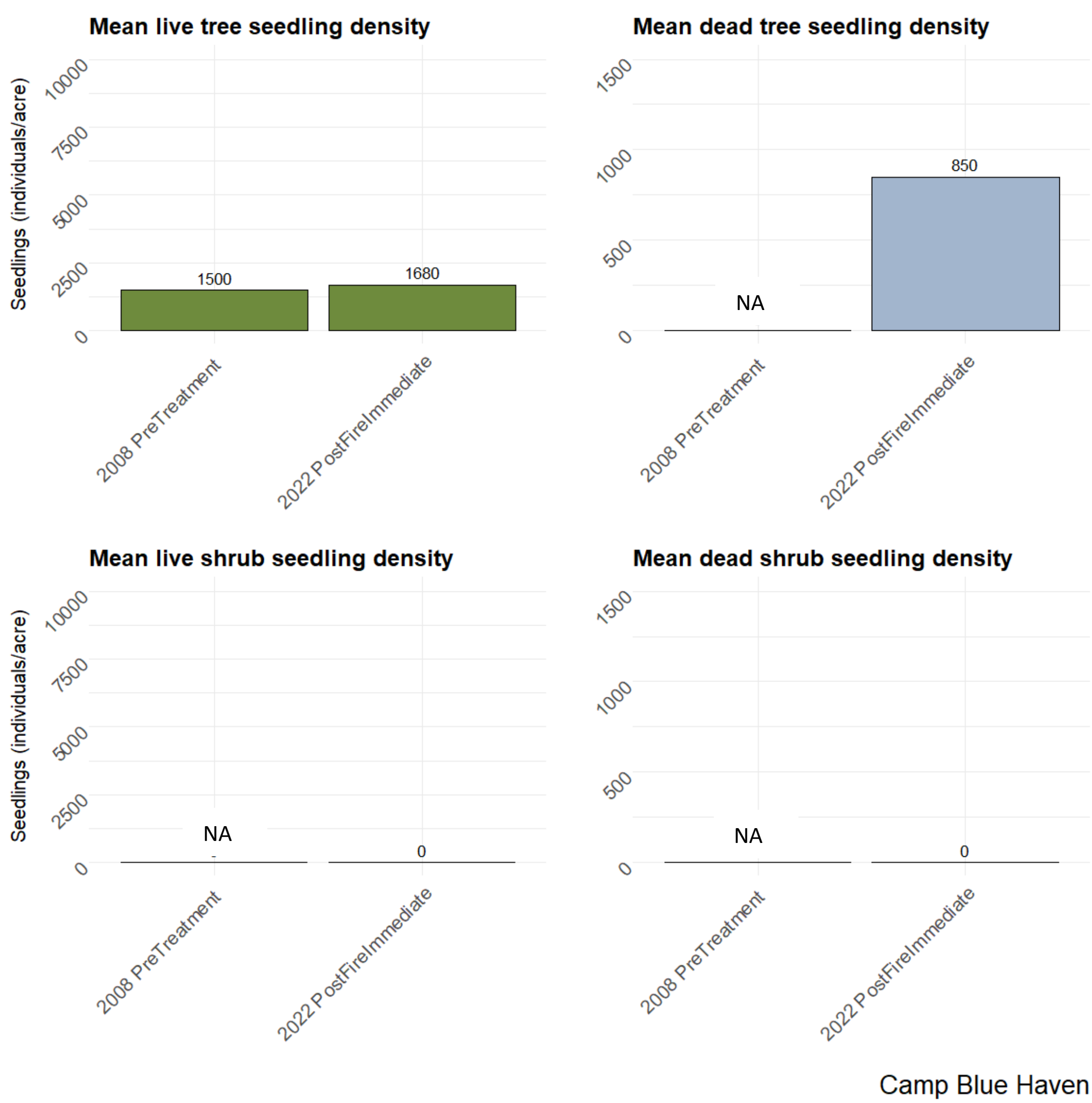

Figure 11. *Regeneration densities of tree seedlings by status across measurement periods.*

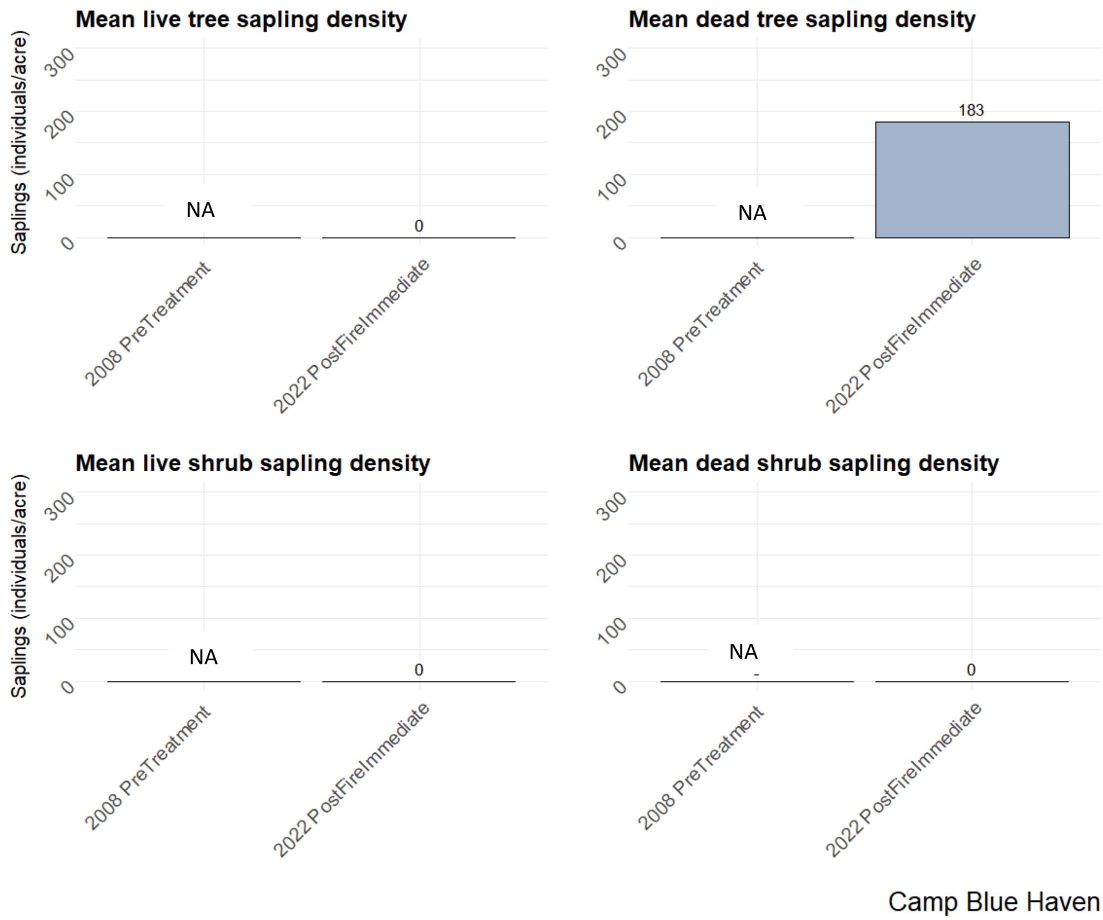

Figure 12. *Regeneration densities of tree saplings by status across measurement periods.*

Understory & Forest Floor Component

Ground & Aerial Cover

Cover collection protocols changed between the 2008 pre-treatment and 2022 post-wildfire immediate measurements. Therefore, values cannot be directly compared between the measurement periods. Pre-treatment, basal vegetation made up the highest percent coverage on plot. Immediately post-wildfire, bare soil had the highest percent ground cover and graminoids had the highest percent aerial cover (excluding tree canopy).

Camp Blue Haven: Ground Cover 2008

Table 5. *Mean percent cover by category for 2008.*

Tree	Seedlings	Shrubs	Graminoids	Forbs	Bare Soil	Gravel
51.7%	0.8%	19%	35%	12.3%	1.3%	0%

Rocks	Duff	Wood	Moss/Lichen	Char	Ash	Basal Veg
2.8%	28.3%	9.3%	0%	0%	0%	52.5%

Camp Blue Haven: Ground Cover 2022

Table 6. *Mean percent ground cover by category for 2022.*

Monitoring Status	PlantBasal	Bole	Litter	BareSoil	Rock	Gravel
2022 PostFireImmediate	27%	2.5%	26%	37%	5.7%	1.8%

Camp Blue Haven: Aerial Cover

Table 7. *Mean percent aerial cover by category for 2022.*

Monitoring Status	Canopy	TreeRegen	Shrubs	Graminoids	Forbs
2022 PostFireImmediate	52%	3.3%	0%	20%	9.8%

Surface Fuels Vegetation (Ladder Fuels)

Pre-treatment ladder fuel data is not available. Immediately post-wildfire, mean percent cover of ladder fuels was measured as 26.1%, with herbaceous live fuel accounting for the highest proportion, followed by standing live, standing dead, and herbaceous dead fuels. Standing dead ladder fuels had the highest mean height at 3.3 ft, followed by standing live fuels at 2.4 ft, herbaceous live fuels at 0.7 ft and herbaceous dead fuels at 0.5 ft. The mean total biomass across all categories was measured at 2.8 tons per acre, with standing live fuels accounting for the majority of this biomass at 2.3 tons per acre, followed by herbaceous live fuels at 0.3 tons per acre, and standing dead fuels at 0.2 tons per acre.

2022 Post-Wildfire Immediate

Fuel	Avg Cover (%)	Avg. Ht (ft)	Avg. Biomass (tons per acre)
HD	0.3	0.5	0.0
HL	14.9	0.7	0.3
SD	0.8	3.3	0.2
SL	10.1	2.4	2.3
Total	**--**	**--**	**2.8**

Surface Fuels

Pre-treatment surface fuel data was not collected. Immediately post-wildfire, total surface fuel loads were calculated at 1.4 tons per acre. No 1000-hour fuels were detected on any plot, so total wood fuel load calculations were comprised entirely of fine fuels at 0.4 tons per acre. Litter & duff loads made up the majority of the total surface fuel load at 0.96 tons per acre collectively.

Camp Blue Haven: Surface Fuels

Table 8. *Fuel loads by type and monitoring status.*

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/a cre)
2022 PostFireImmediate	0.0026	0.25	0.14	0	0	0.75	0.21	**0.4**	**0.4**	**1.4**

Fine Fuels, Litter & Duff

Immediately post-wildfire, fine fuel loads were calculated at 0.4 tons per acre. The majority of this load is attributed to 10-hr fuels at 0.25 tons per acre, followed by 100-hr fuels at 0.14 tons per acre, and a small proportion of 1-hr fuels at 0.0026 tons per acre. Litter and duff loads collectively totaled 0.96 tons per acre, with litter comprising the majority at 0.75 tons per acre and duff comprising the remaining 0.21 tons per acre.

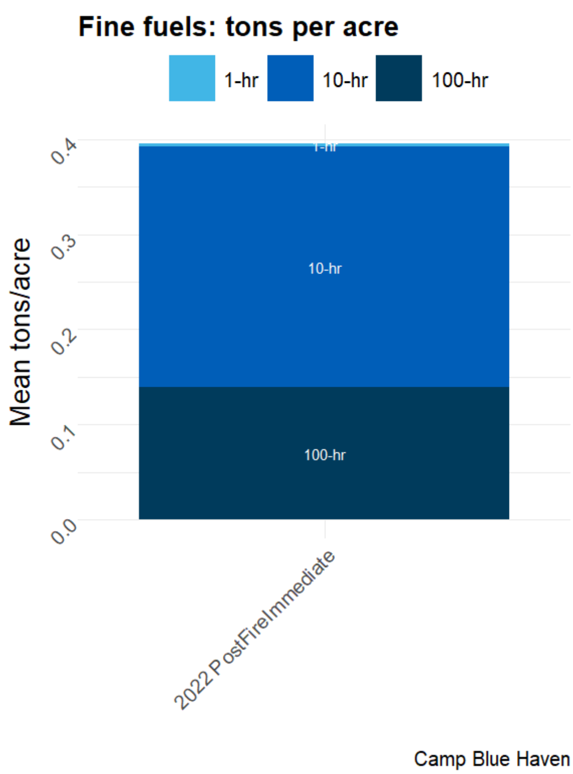

Figure 13. *Mean fine fuel loads.*

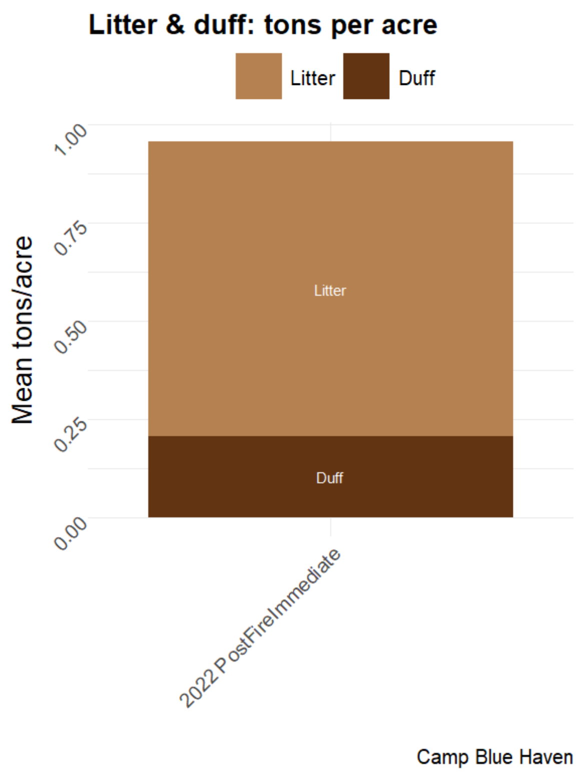

Figure 14. *Mean litter and duff loads.*

Thousand-Hour Fuels

No thousand-hour fuels were detected on any plot.

Photo Comparisons

BH_02_E

2008 Pre-Treatment

2022 Post-Wildfire Immediate

BH_05_S

BH_08_W

2008 Pre-Treatment

2022 Post-Wildfire Immediate

Works Cited

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A. Conklin, D., & A. Armstrong, W. (2005). Effects of Three Prescribed Fires on Dwarf Mistletoe Infection in Southwestern Ponderosa Pine. *United States Department of Agriculture Forest Service*. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5238544.pdf

New Mexico Forest and Watershed Restoration Institute. (2023). *Hermit's Peak and Calf Canyon Fire*. ArcGIS StoryMaps. https://storymaps.arcgis.com/stories/d48e2171175f4aa4b5613c2d11875653

Southwest Forest Health and Wildfire Prevention Act of 2004, no. 108–317, 108th Congress (2004). https://www.congress.gov/108/plaws/publ317/PLAW-108publ317.pdf

Supplementary Information

Species List

Table 9. *List of observed tree species by species symbol, scientific name, and common name*

Species Symbol	Scientific Name	Common Name
PINUS	*Pinus sp.*	pine species
PIPO	*Pinus ponderosa*	ponderosa pine
QUERC	*Quercus sp.*	oak species
QUGA	*Quercus gambelii*	Gambel oak
QUUN	*Quercus undulata*	wavy-leaf oak

Abbreviations & Acronyms

Acronym/Abbreviation/Term	Definition as used by NMFWRI
1-hr fuel	Woody surface debris < 0.25 inches in diameter
10-hr fuel	Woody surface debris 0.25 – 1 inch in diameter
100-hr fuel	Woody surface debris 1.0 – 3.0 inches in diameter
1000-hr fuel	Woody surface debris > 3.0 inches in diameter
Avg	Average
CFRP	Collaborative Forest Restoration Program
DBH	Diameter at breast height (4.5 feet)
FFI	FEAT/FIREMON Integrated

FEAT	Fire Ecology Assessment Tool
FIREMON	Fire Effects Monitoring and Inventory System
Growing stock	A combination of live and “sick” trees, excluding snags
HD	Herbaceous dead (dead non-woody species)
HL	Herbaceous live (live non-woody species)
NMFWRI	New Mexico Forest and Watershed Restoration Institute
NMSLO	New Mexico State Land Office
USFS	United States Forest Service
Sapling	Height > 4.5 feet & DBH < 1 inch
Seedling	Height <4.5 feet
Shrub	A woody species with multiple stems arising at the ground
SD	Standing dead (dead woody species)
SL	Standing live (live woody species)
“Sick”	Attribute given to trees/shrubs not expected to survive long term
Snag	Standing dead tree
Sqft/ac	Square feet per acre
SWERI	Southwest Ecological Restoration Institute
TPA	Trees per acre (trees/acre)
Tree	Height > 4.5 feet & DBH > 1 inch

Plot Coordinates

***Table 10**. GPS Coordinates to plot center locations*

Plot Name	Longitude	Latitude
BH_02	-105.4284111	35.63575113
BH_04	-105.4284056	35.63490169
BH_05	-105.4294	35.63409461
BH_06	-105.428399	35.63411816
BH_07	-105.4293809	35.63328574
BH_08	-105.4284185	35.63328605

Treatment Prescription

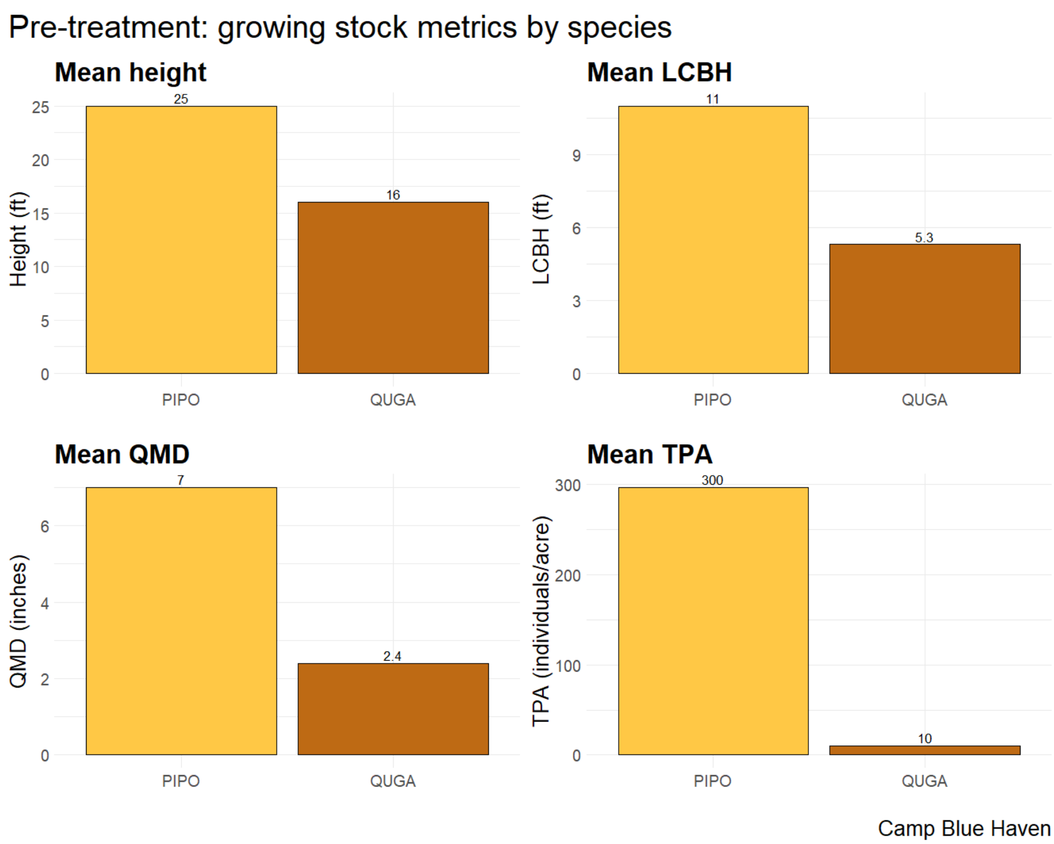
Bluehaven Prescription: provided by NMSLO

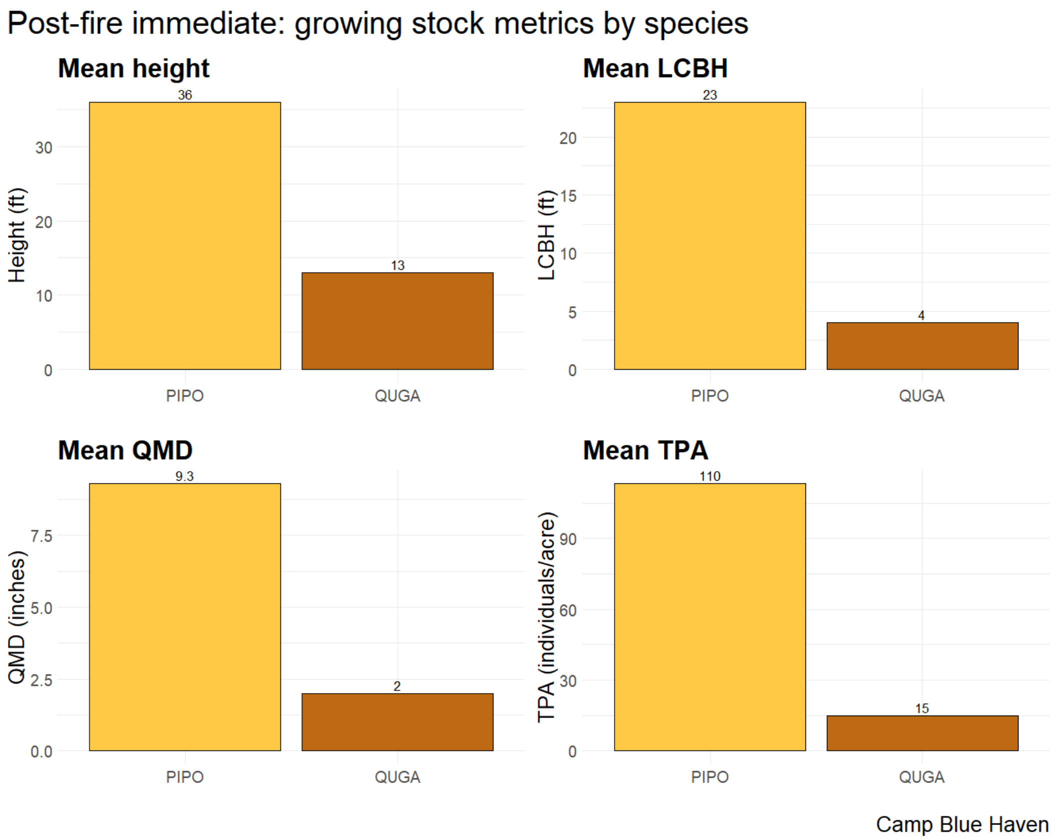
- Thin the stand to a residual basal area of 60 square feet per acre or less.
- The residual stand will be clumpy and as uneven aged in structure as the existing stand structure will allow.
- The contractor will chip the majority of the slash. In areas that are inaccessable by a chipper the slash will be lopped and scattered.

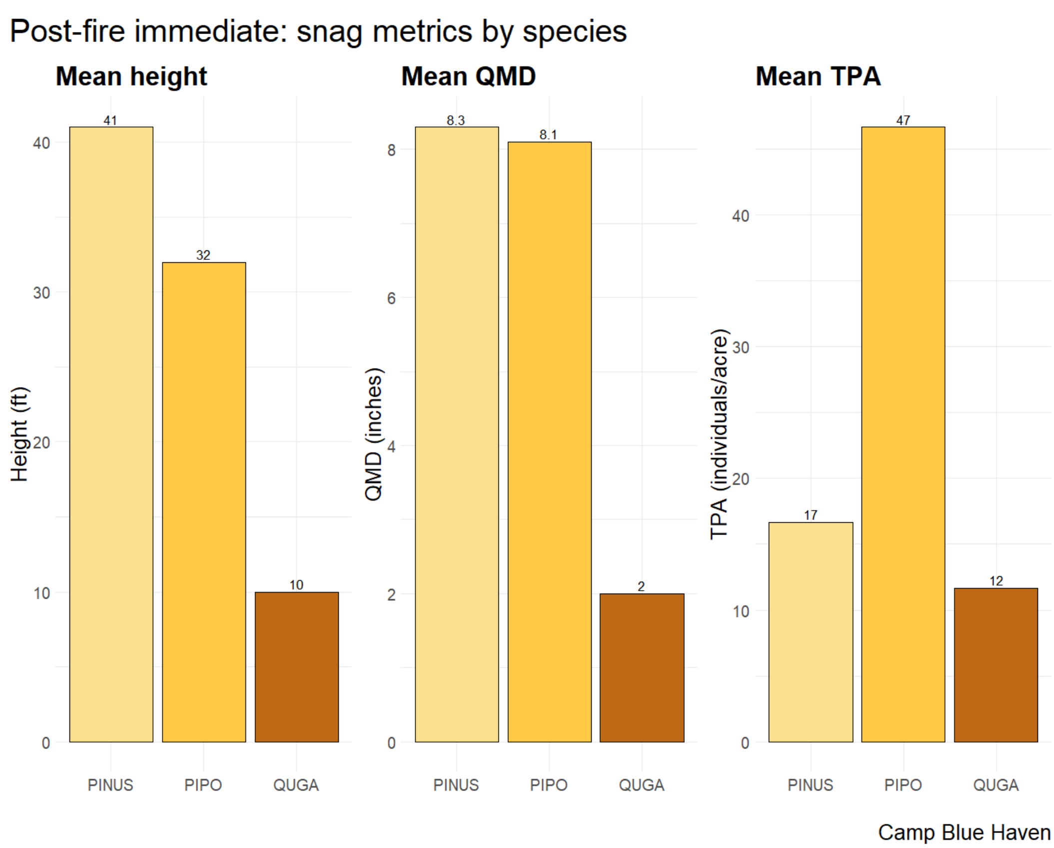
- The State Land Office and Camp Blue Haven will remove trees as needed to maintain the project once regeneration and additional tree growth occurs.
- New Mexico Forest & Wathershed Health Institute at Highlands will assist with monitoring the project by putting in inventory and photo points within the project area.

Additional Figures

Figure 15. *Overstory tree metrics by species, status, and monitoring period*




Post-fire immediate: growing stock metrics by species
Mean height
Height (ft)
36
13
PIPO
QUGA
Mean LCBH
LCBH (ft)
23
4
PIPO
QUGA
Mean QMD
QMD (inches)
9.3
2
PIPO
QUGA
Mean TPA
TPA (individuals/acre)
110
15
PIPO
QUGA
Camp Blue Haven


Post-fire immediate: snag metrics by species
Mean height
Height (ft)
41
32
10
PINUS
PIPO
QUGA
Mean QMD
QMD (inches)
8.3
8.1
2
PINUS
PIPO
QUGA
Mean TPA
TPA (individuals/acre)
17
47
12
PINUS
PIPO
QUGA
Camp Blue Haven

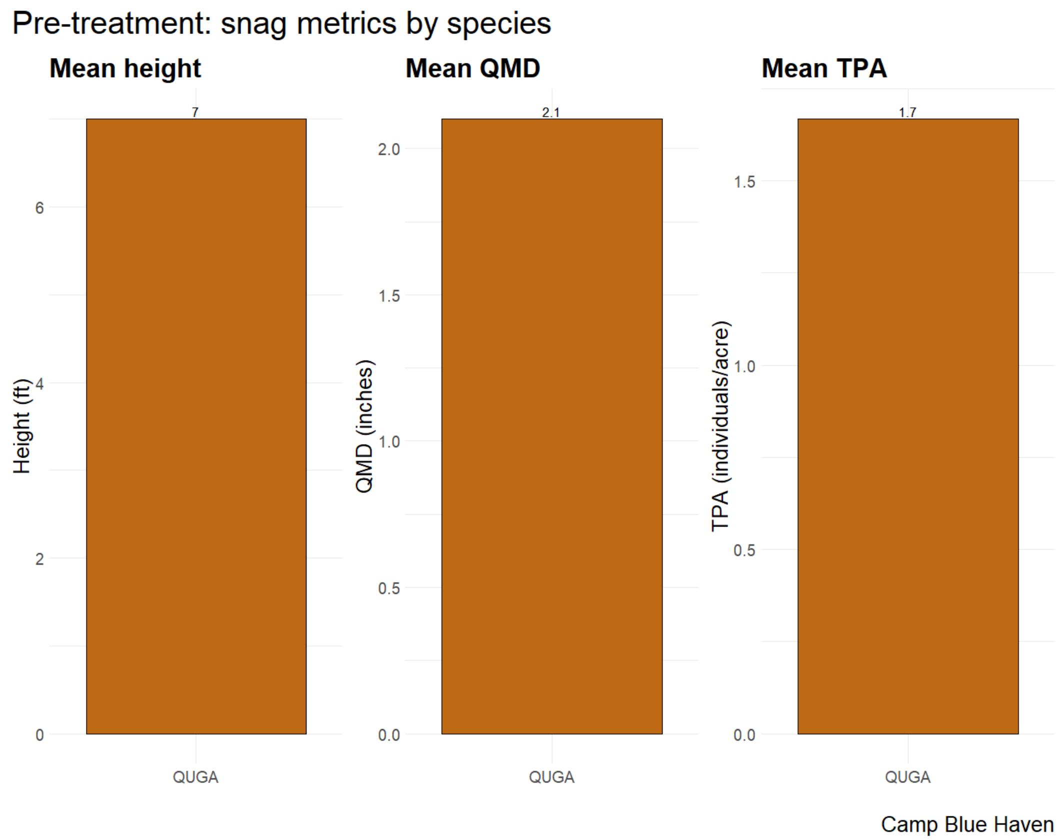
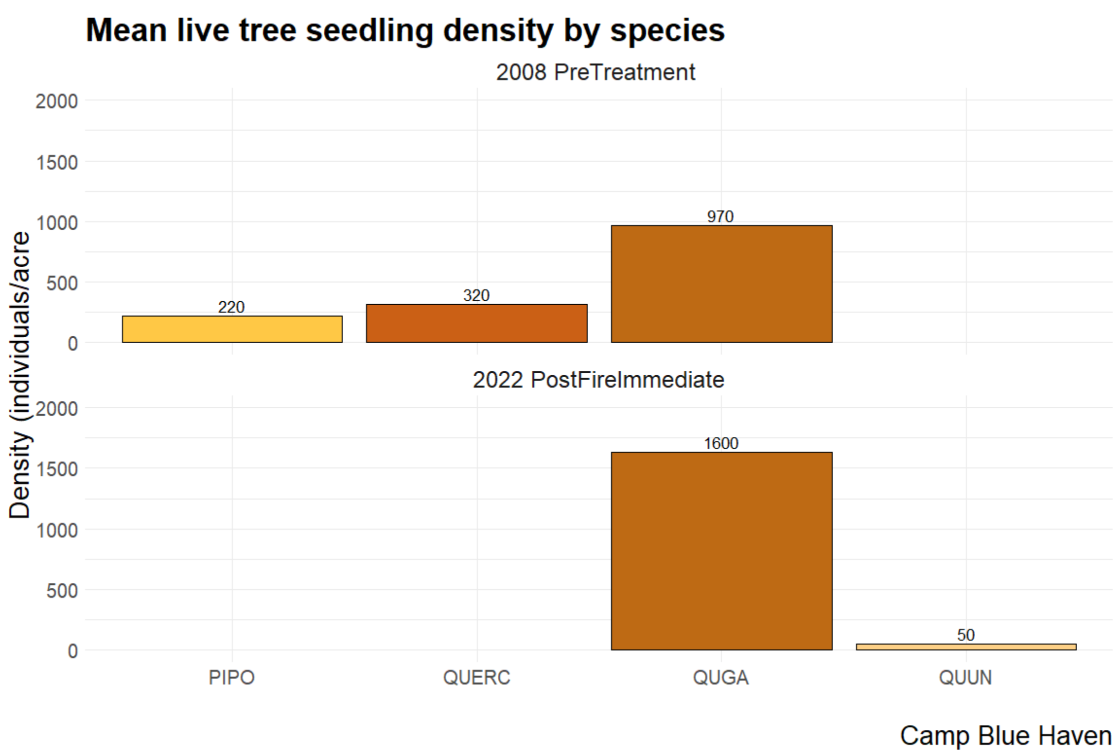
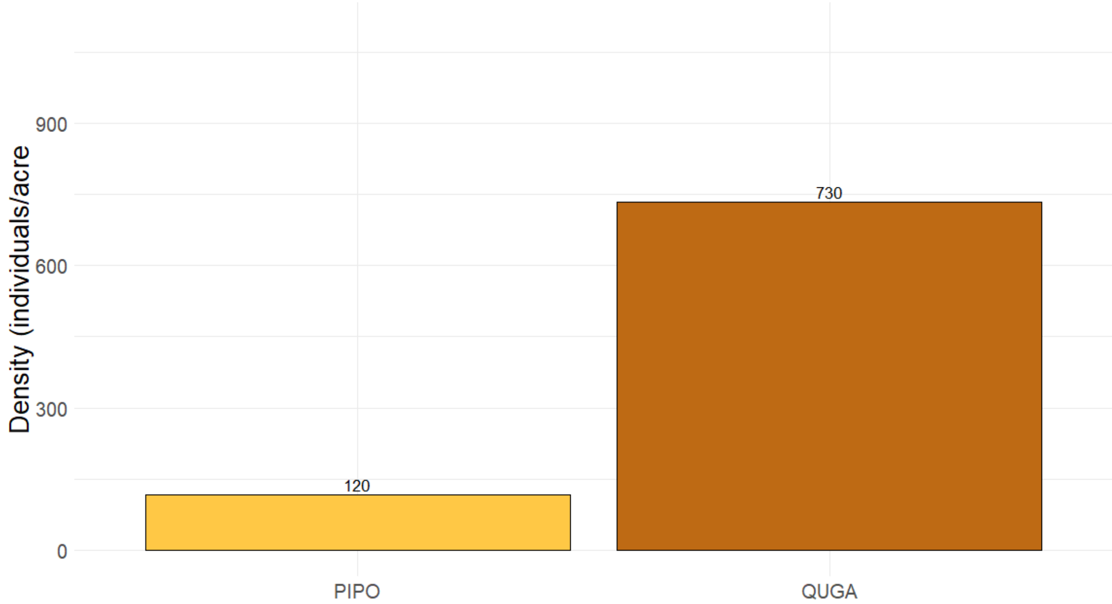


__Figure 16.__ The following figures show seedling and sapling densities by status and species across measurement periods.



Mean dead tree seedling density by species

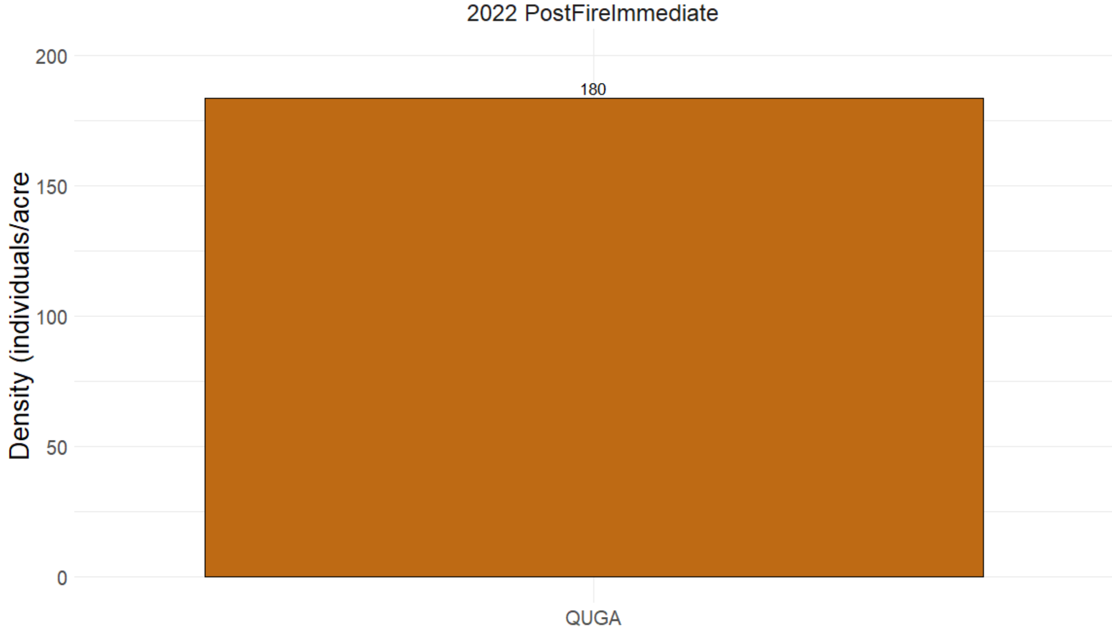
2022 PostFireImmediate



Camp Blue Haven

Mean dead tree sapling density by species

2022 PostFireImmediate



Camp Blue Haven