



National Park Service North Pacific/Columbia Basin Fire Ecology Program Fire Ecology Annual Report Calendar Year 2025

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Conducting burn severity assessments within the 2024 Pioneer burn scar. (Photo credit: K. Patronik)

The National Park Service (NPS) Division of Fire and Aviation Management relies on science and long-term monitoring to inform an adaptive management approach for assessing and improving fire management programs and activities at park units. Adaptive management, along with policies, standards, and responsibilities for monitoring are described in Chapter 8 of [Reference Manual 18](#). The NPS Fire Ecology Program is responsible for the collection, analysis, and interpretation of fire effects monitoring data for park managers to use for program evaluation and decision making. This annual report is intended to partially fulfill reporting requirements for the Fire Ecology Program and does not constitute a complete analysis of any NPS fire management program or activity. Additional interpretation and reporting can be found in previous annual reports at [NPS DataStore](#) or by contacting the author(s) of this report.

Table of Contents

A. Summary	3
B. Monitoring Results and Recommendations	5
NOCA Westside Units: Understanding Current Conditions to Inform Management Decisions	5
ELC	6
ELC Transmission Line	6
Newhalem Unit 1	6
Newhalem Unit 2	6
Hozomeen	6
NOCA Westside Units: Diablo Unit Response Following 2023 Sourdough Wildfire.....	14
NOCA Contour Units: Effects of Two Wildfire Events in Open Versus Closed Canopy Mixed Conifer Forest in the Stehekin Valley.....	23
NOCA 2024 Pioneer and Ruby Fire Composite Burn Index: Ground-truthing Burn Severity Satellite Imagery	35
C. Research, Planning, and Communication	41
D. Future Direction for NPCB Fire Ecology Program	41
E. References, Links, and Additional Reading.....	42
Appendix A. Staffing and Accomplishments	43
Appendix B. History of Fire Effects Monitoring Plots.....	46
Table B-1. All Fire Effects Plots Established	46

A. Summary

During the 2025 field season, the North Pacific/Columbia Basin (NPCB) Fire Ecology Program completed a total of 32 Fire Monitoring Handbook (FMH) plots within North Cascades National Park Service Complex (NOCA) and Lake Roosevelt National Recreation Area (LARO) (*Table 1*). The crew also sampled 51 Composite Burn Index (CBI) plots within the 2024 Pioneer Fire and 2024 Ruby Fire in NOCA (*Table 1*). In addition to fire effects plotwork, the crew utilized Burned Area Rehabilitation (BAR) funding to assist another NOCA crew in identifying potential whitebark pine (*Pinus albicaulis*) seed trees for burn scar reseeded efforts across the Stephen Mather Wilderness in NOCA. The crew also engaged in wildfire assignments, prescribed burns, and a variety of fire trainings throughout the season.

Early Season: In January 2025, Cedar Drake, the previous NPCB Lead Fire Effects Monitor, transitioned into the role of NPCB Fire Ecologist. Winter months for the Lead Fire Effects Monitor, Kate Patronik, consisted of assisting in the hiring of seasonal crewmembers and coordinating logistics for the 2025 field season. The spring of 2025 presented a myriad of administrative challenges associated with changes to policy related to training, purchasing, and hiring. Travel for training courses and workshops was suspended, which impacted a number of training



Figure 1. NPCB Fire Effects Crew conducting FMH plot reads at LARO.

opportunities for the Fire Ecologist and Lead Monitor. In late April, three seasonal NPCB fire effects monitors were onboarded. These individuals, Isaac Comcowich, Bella Myrah, and Cade Simpson, had all worked on the NPCB Fire Effects Crew in 2024. The crew attended RT-130 and completed the Pack Test within their first week which enabled them to travel to LARO and assist with a prescribed burn and engage in cross-training with the NOCA Wildland Fire Module (WFM). This training included first-aid/CPR, fireline prep, fuel transect protocols, and a chainsaw refresher. While at LARO, one crewmember assisted with an initial attack response. Once prescribed burning and cross-training was complete in early May, the Lead Monitor took a fire assignment to New Mexico with the NOCA WFM, and during this time the crew commenced FMH plotwork at LARO.

Mid-Season: By early June, the majority of FMH plots at LARO had been completed, and the crew transitioned to completing FMH plots in the Stehekin Valley in NOCA. By mid-July, the crew completed all FMH work in Stehekin and the few remaining plots at LARO. With the majority of FMH plots completed, the crew shifted their focus to collecting Composite Burn Index (CBI) data within the 2024 Pioneer Fire burn scar. In early and mid-August, crew members engaged in a variety of fire assignments, by providing crewmembers to support the NOCA WFM, the Olympic WFM, and Yellowstone Helitack. While rotating crewmembers

through fire assignments, the other crewmembers completed FMH plots that burned in the 2023 Sourdough Fire and collected CBI data within the 2024 Ruby Fire burn scar. At the end of August, a lightning storm ignited three fires across the northwestern section of the NOCA. The Fire Ecologist served as the Lead READ and the Lead Monitor assisted with the creation of maps necessary for fire operations. The Perry Fire, the most significant of these lightning-caused fires, was staffed by the Whiskeytown WFM. NPCB fire effects monitors served as REAF trainees embedded within the WFM. Additionally, one fire effects crew member staffed the nearby Desolation lookout to serve as a human repeater and lookout in support of Perry Fire operations.

Late Season: With all fire ecology monitoring work completed by September, the crew assisted the NOCA Whitebark Pine Monitoring Crew for one pay period. By late September, weather was too wet for further whitebark pine fieldwork to be completed and these efforts were curtailed. Seasonal employees ended their seasons on September 30th. The Lead Monitor and Fire Ecologist assisted with pile burning at LARO during the government shutdown and into mid-November.



Figure 2. Reading Brown's Lines at LARO.

Table 1. Fire Effects Plot Workload (2025)

Park	Monitoring Unit	Plot Type	Years Data Collected (start-end)	Annual Total (2025)	Total Plots
North Cascades National Park Service Complex	Stehekin Valley FFRA: Mixed Conifer	FMH Forest Plot	1996-2025	13	54
	Westside Plots	FMH Forest Plot	2021-2025	4	26
	2024 Pioneer Fire	CBI	2025	41	41
	2024 Ruby Fire	CBI	2025	10	10
Lake Roosevelt National Recreation Area	Ponderosa Pine / Common Snowberry Forest	FMH Forest Plot	2001-2025	15	60
Total				83	191

B. Monitoring Results and Recommendations

NOCA Westside Units: Understanding Current Conditions to Inform Management Decisions

The western slope of the North Cascades has experienced an increased frequency of large wildfires across the landscape over the past ten years. In response to this trend, fire and resource managers at North Cascades National Park Complex (NOCA) are evaluating management strategies to protect vulnerable infrastructure from impacts associated with wildfires. To assist in informing fuels treatment strategies in these areas, the “Westside” Fuel Reduction Units in NOCA have been established along the western flank of the Complex within the Ross Lake National Recreation Area (ROLA) in the vicinity of high-use public areas and critical federal and Seattle City Light (SCL) infrastructure (*Figure 3*).

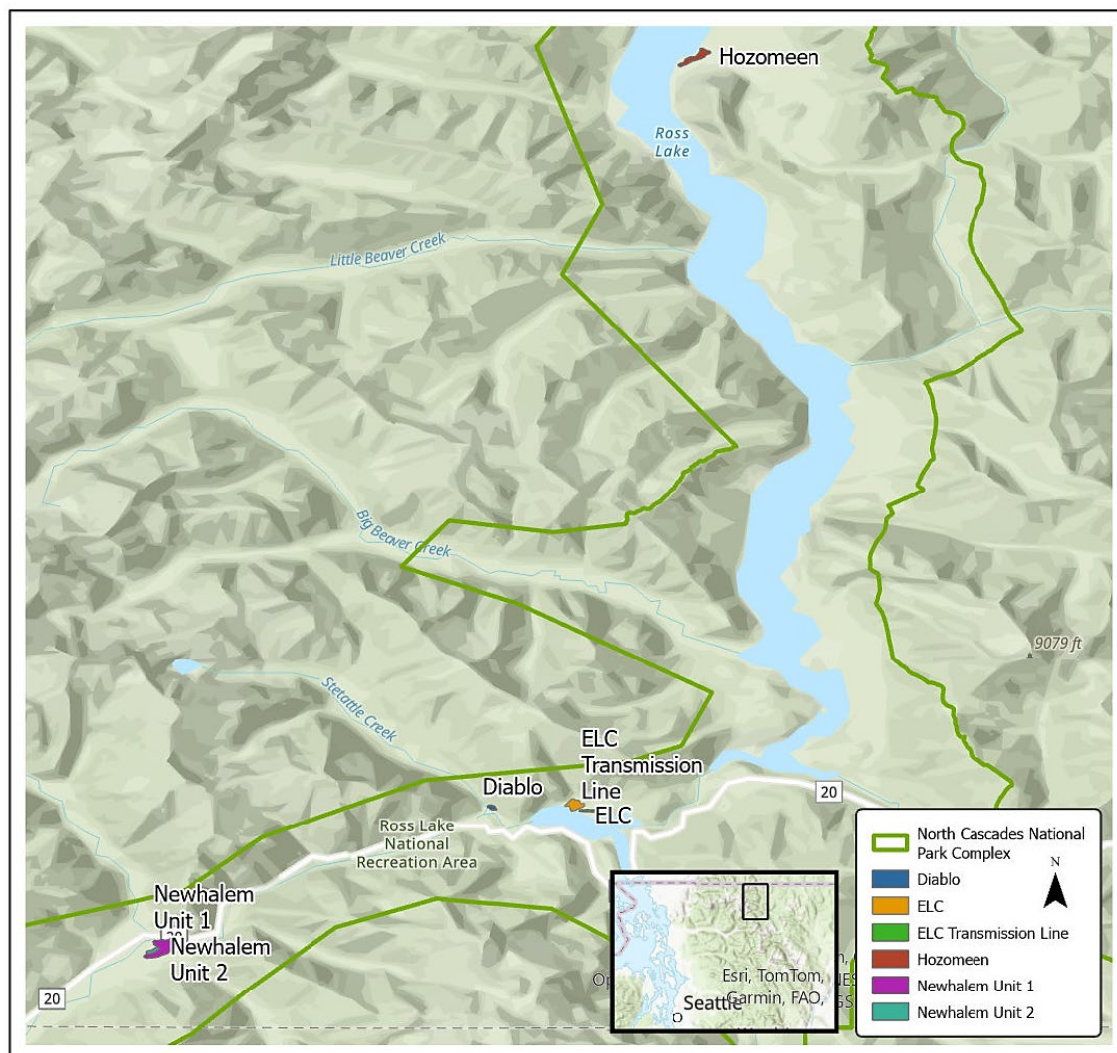


Figure 3. Map of NOCA Westside Unit Locations.

In 2021, the NPCB Fire Effects Crew installed 26 FMH plots throughout the 6 Westside Units to gain a better understanding of local vegetation and fuel conditions and to provide a baseline for monitoring fuels treatments once they had been completed. Data from these monitoring efforts be used to inform effective fuels reduction strategies and site-specific fuels treatment prescriptions in order to meet hazard fuel reduction goals and, to the greatest degree possible, retain the ecological structure and function typical of these forests.

Each Westside Unit varies in vegetative composition as described in the respective monitoring type descriptions:

ELC (Environmental Learning Center)

Mixed conifer closed canopy forest dominated by Douglas fir (*Pseudotsuga menziesii*) with a variable component of western hemlock (*Tsuga heterophylla*) and other conifers.

ELC Transmission Line

Immature stand of lodgepole pine (*Pinus contorta*) composed primarily of lodgepole pine seedlings and saplings (30-100% cover) with scattered larger diameter lodgepole pine.

Newhalem Unit 1

Mixed conifer closed canopy forest dominated by western hemlock (*Tsuga heterophylla*), Douglas fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*) (30-100% cover). May have a component of pine (e.g. *Pinus contorta* and/or *Pinus monticola* (0 - 5%).

Newhalem Unit 2

Mixed conifer closed canopy forest dominated western hemlock (*Tsuga heterophylla*), Douglas fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*) (25-90% cover) with a component of lodgepole pine (*Pinus contorta*) and/or western white pine (*Pinus monticola*) (5-75%).

Hozomeen

Mixed conifer closed canopy forest dominated by Douglas fir (*Pseudotsuga menziesii*) (20 -100% cover) with a variable component of western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*) (0 - 50% cover) and other conifers (e.g. lodgepole pine, (*Pinus contorta*), western white pine (*Pinus monticola*), or grand fir (*Abies grandis*) (0 - 30%).

The following monitoring results (*Table 2*) indicate the baseline conditions for five of the six Westside Units as they were sampled in 2021. Results for the Diablo Unit will be addressed later in this report as this unit was burned by the Sourdough Fire in 2023.

Table 2. NOCA Westside Fuel Reduction Units: Pre-treatment Data (collected in 2021)

Monitoring Unit	Stand Indicators	Initial Monitoring Results
		(with 90% Confidence Interval)
<i>ELC: Western Hemlock Mixed Conifer with Pine</i> 4 plots	Average Stand Density (trees/ac)	poles (2.5 < 15cm DBH): 121.4 trees/ac, 90%CI [0.0, 243.1]
		overstory (15 < 60cm DBH): 107.2 trees/ac, 90%CI [88.7, 125.8]
		lg overstory (60cm < max DBH): 18.21 trees/ac, 90%CI [8.6, 27.8]
	Average Height to Live Crown (m)	10.4 meters, 90%CI [8.3, 11.8]
	Average Basal Area (sq. ft. /ac)	189.0 ft ² /ac, 90%CI [155.9, 222.0]
	Tonnage of fuels	Fine: 3.6 tons/ac, 90%CI [2.0, 5.1] 1000-hr: 18.6 tons/ac, 90%CI [8.9, 28.2] Litter and Duff: 23.7 tons/ac, 90%CI [14.3, 33.0] Total: 45.8 tons/ac, 90% CI [27.6, 64.0]
	Density of Seedlings	2195 seedlings/ac, 90%CI [934, 3455]
	Understory Cover	Native: 89.4%, 90%CI [76.3, 102.3] Non-Native: none observed
		Moss: 49.1%, 90%CI [30.6, 67.6]
<i>ELC Transmission Line: Immature Lodgepole Pine Stand</i> 4 plots	Average Stand Density (trees/ac)	poles (2.5 < 15cm DBH): 799.3 trees/ac, 90%CI [327.9, 1271.0]
		overstory (15 < 60cm DBH): 66.78 trees/ac, 90%CI [7.1, 126.5]
		lg overstory (60cm < max DBH): none observed
	Average Height to Live Crown (m)	5.3 meters, 90%CI [4.1, 6.4]
	Average Basal Area (sq. ft. /ac)	56.4 ft ² /ac, 90%CI [17.3, 95.5]
	Tonnage of fuels	Fine: 0.9 tons/ac, 90%CI [0.6, 1.1] 1000-hr: 3.0 tons/ac, 90%CI [1.3, 4.6] Litter and Duff: 18.4 tons/ac, 90%CI [12.8, 24.1] Total: 22.3 tons/ac, 90% CI [15.0, 29.6]
	Density of Seedlings	1043 seedlings/ac, 90%CI [564, 1522]
	Cover of Understory Plants	Native: 59.3%, 90%CI [40.5, 78.2] Non-Native: none observed
		Moss: 21.4%, 90%CI [10.1, 32.6]
<i>Newhalem Unit 1: Western Hemlock Mixed Conifer</i> 5 plots	Average Stand Density (trees/ac)	poles (2.5 < 15cm DBH): 79.3 trees/ac, 90%CI [48.0, 110.6]
		overstory (15 < 60cm DBH): 126.3 trees/ac, 90%CI [95.0, 157.5]
		lg overstory (60cm < max DBH): 34.0 trees/ac, 90%CI [26.5, 41.5]
	Average Height to Live Crown (m)	10.1 meters, 90%CI [7.4, 12.8]
	Average Basal Area (sq. ft. /ac)	334.2 ft ² /ac, 90%CI [297.2, 371.2]
	Tonnage of fuels	Fine: 1.7 tons/ac, 90%CI [1.5, 2.0] 1000-hr: 14.5 tons/ac, 90%CI [6.3, 15.0] Litter and Duff: 51.1 tons/ac, 90%CI [35.6, 66.6] Total: 67.4 tons/ac, 90% CI [36.0, 98.7]
	Density of Seedlings	524 seedlings/ac, 90%CI [353, 695]
	Cover of Understory Plants	Native: 64.3%, 90%CI [45.1, 83.5] Non-Native: none observed
		Moss: 79.3%, 90%CI [68.1, 90.4]

<i>Newhalem Unit 2: Western Hemlock Mixed Conifer with Pine</i> <i>3 plots</i>	Average Live Stand Density (trees/ac)	poles (2.5 < 15cm DBH): 339.3 trees/ac, 90%CI [194.0, 484.5]
		overstory (15 < 60cm DBH): 240.5 trees/ac, 90%CI [225.7, 255.2]
		lg overstory (60cm < max DBH): 2.7 trees/ac, 90%CI [0.5, 4.9]
	Average Height to Live Crown (m)	8.7 meters, 90%CI [7.3, 10.2]
	Average Basal Area (sq. ft. /ac)	124.4 ft ² /ac, 90%CI [0.3, 248.4]
	Tonnage of fuels	Fine: 2.1 tons/ac, 90%CI [1.2, 3.0] 1000-hr: 10.7 tons/ac, 90%CI [6.3, 15.0] Litter and Duff: 42.4 tons/ac, 90%CI [34.0, 50.7] Total: 55.1 tons/ac, 90% CI [38.5, 71.8]
	Density of Seedlings	744 seedlings/ac, 90%CI [563, 925]
	Cover of Understory Plants	Native: 44.1%, 90%CI [39.8, 48.5] Non-Native: none observed
		Moss: 89.8%, 90%CI [81.7, 97.8]
<i>Hozomeen: Douglas Fir Mixed Conifer</i> <i>6 plots</i>	Average Stand Density (trees/ac)	poles (2.5 < 15cm DBH): 190.9 trees/ac, 90%CI [117. 265]
		overstory (15 < 60cm DBH): 197.6 trees/ac, 90%CI [144, 251]
		lg overstory (60cm < max DBH): 3.4 trees/ac, 90%CI [1, 5]
	Average Height to Live Crown (m)	10.5 meters, 90%CI [7.6, 13.4]
	Average Basal Area (sq. ft. /ac)	207.9 ft ² /ac, 90%CI [176.7, 239.1]
	Tonnage of fuels	Fine: 2.8 tons/ac, 90%CI [1.9, 3.7] 1000-hr: 13.1 tons/ac 90%CI [7.4, 18.8] Litter and Duff: 59.1 tons/ac, 90%CI [48.6, 69.5] Total: 75.0 tons/ac, 90% CI [56.4, 93.5]
	Density of Seedlings	1035 seedlings/ac, 90%CI [609, 1461]
	Cover of Understory Plants	Native: 59.5%, 90%CI [51.4, 67.6] Non-Native: None observed
		Moss: 51.9%, 90%CI [28.2, 75.6]

Trees and seedlings:

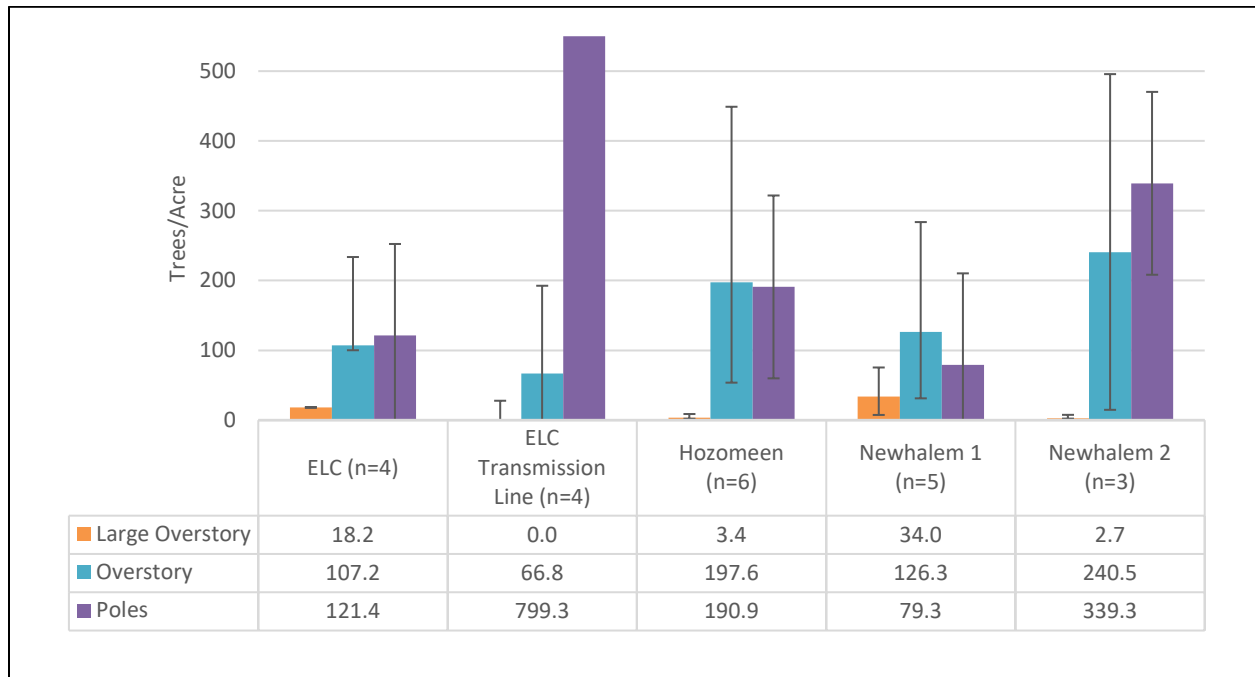


Figure 4. Comparison of average live stand density by size class (with 90% confidence interval) between Westside Units.

The relationship between tree density and basal area appears to be directly related to the number of large overstory trees in the unit. For example, Newhalem Unit 1 presents as the Westside Unit with the greatest density of large overstory (>60cm DBH) trees (34 trees/acre) and correspondingly indicates the highest basal area (334.2 ft. sq./ac) (Table 2). Similarly, the ELC Transmission Line Unit is characterized by the lowest basal area (56.4 ft. sq./ac.) and has no large overstory trees but the most pole sized (2.5cm > 15cm DBH) trees.

Height to live crown across the Westside Units is similar, except for the ELC Transmission Line Unit. Given the large number of pole sized trees per acre in the ELC Transmission Line Unit, it has the lowest height to live crown (5.3 meters). The other units present an average height to live crown between 8.7 to 10.5 meters (Table 2).

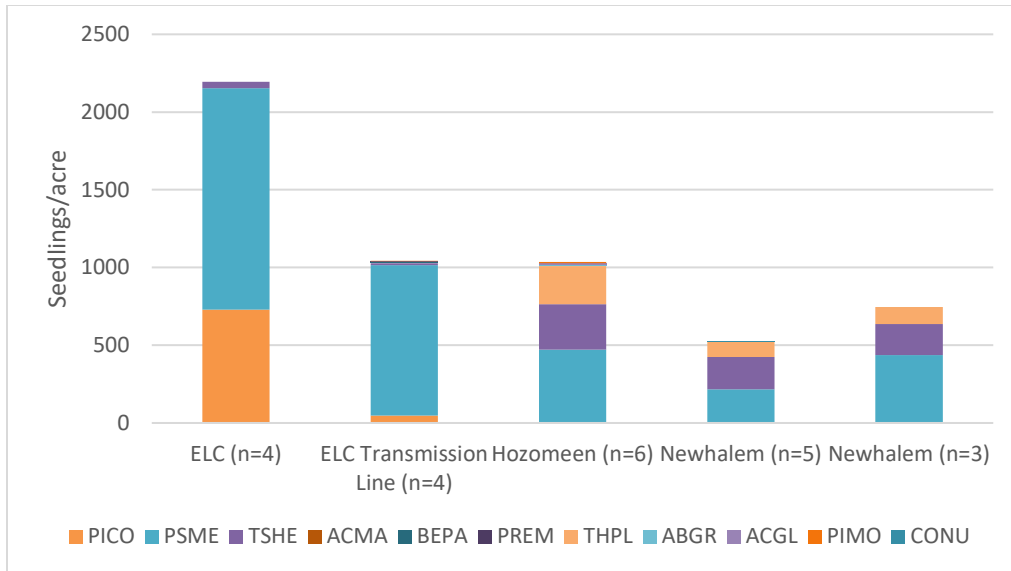


Figure 5. Comparison of average seedling density by species between Westside Units.

Seedling density across the Westside Units indicates an average density between 524 seedlings/acre in the Newhalem unit and 2195 seedlings/acre in the ELC unit (*Figure 5*). Monitoring results indicate Douglas fir (PSME) as the dominant species of seedlings with Western Hemlock (TSHE) as the second most common seedling across all units. Deciduous species, like Bigleaf Maple (ACMA), are present within the units but are not common.

Fuels:

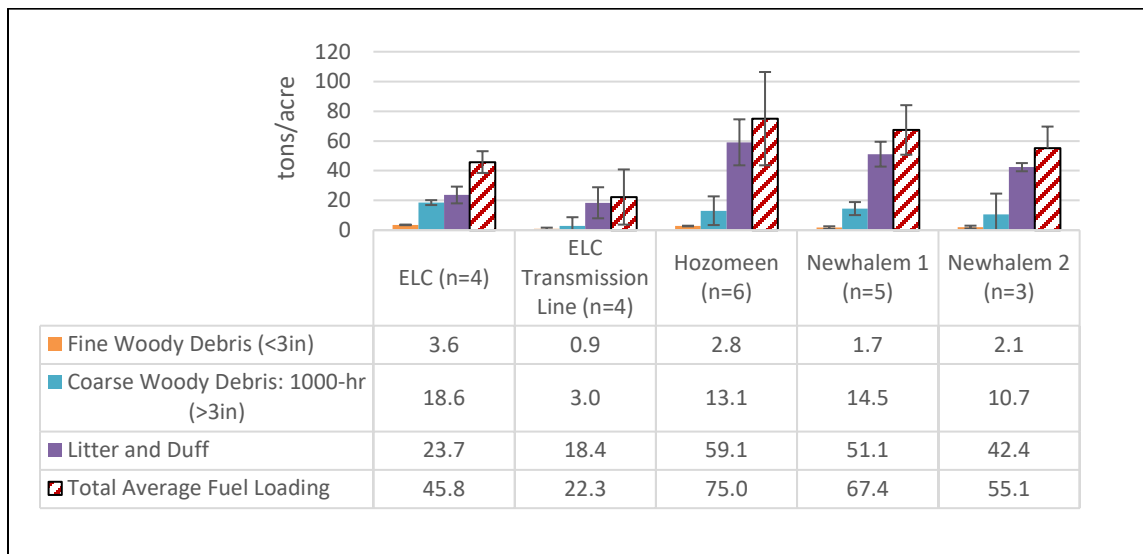


Figure 6. Comparison of average fuel loading by size class (with 90% confidence interval) among Westside Units.

Litter and duff contribute to the highest tonnage of fuels across all units, followed by 1000-hr coarse woody debris (>3in) (*Figure 6*). The average depth of litter and duff ranged from between 4.8 inches at the ELC Transmission Line unit to 24.8 inches in the Hozomeen unit. Coarse woody debris was highest at the ELC unit (18.6 tons/acre), and lowest at the ELC Transmission Line Unit (3.0 tons/acre).

Understory Cover:

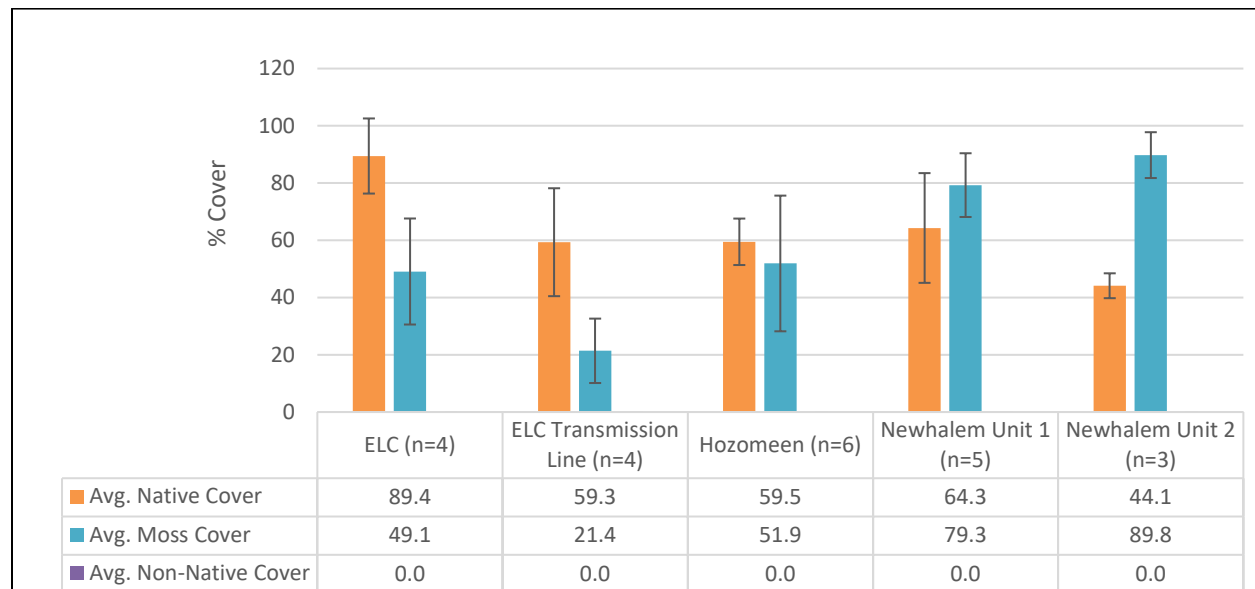


Figure 7. Comparison of average understory cover (with 90% confidence interval) among Westside Units.

Within the initial dataset collected in 2021, no non-native species were observed within any of the twenty-six Westside Unit plots. Average native understory cover is highest within the ELC unit (89.4%) and lowest in the Newhalem 2 unit (44.1%) (*Figure 7*). Within the Westside Units, shrub cover ranged from a low of 32.7% within the Newhalem 2 Unit to a high of 64.9% at the ELC Unit. Forb and herb cover is less than shrub cover in all units and graminoids are minimally present across all units. Forests along the western slope of the Cascades typically bear a substantial understory moss component which can readily carry surface fire during dry summer months. Moss is present at the highest degree of cover within the Newhalem 2 unit (89.9%) and at the lowest degree of cover within the ELC Transmission Line unit (21.4%).

Westside Units Representative Photos:

ELC Transmission Line Unit



ELC Unit



Hozomeen Unit



Newhalem Unit 1



Newhalem Unit 2



NOCA Westside Units: Diablo Unit Response Following 2023 Sourdough Wildfire

The four Diablo Unit plots were installed in 2021 with the same goals as the other Westside Unit plots; however the unit burned in 2023 during the Sourdough Fire. The Sourdough Fire was ignited by lightning on July 29th, 2023, on steep rocky slopes within NOCA adjacent to the town of Diablo and was managed under a full-suppression strategy to protect nearby critical infrastructure.

The following data indicate data associated with four FMH plots within the Diablo Unit relative to pre-fire, year-1 post Sourdough Wildfire, and year-2 post Sourdough Wildfire monitoring visits.

Table 3. Diablo Unit Monitoring: Pre-, 1-, and 2- Years Post Sourdough Fire

Monitoring Indicators	Monitoring Results (with 90 % Confidence Interval)		
	<i>Pre-Fire (n=4)</i>	<i>Year 1 Post 2023 Sourdough Wildfire (n=4)</i>	<i>Year 2 Post 2023 Sourdough Wildfire (n=4)</i>
Average Density of Live Trees (trees/ac)	poles = 2.5cm > 15 cm DBH, overstory: 15 cm > 60 cm DBH, lg overstory: 60 > max DBH		
	poles: 130.5 trees/ac, 90%CI [102, 159]	poles: 5.1 trees/ac, 90%CI [1, 9]	poles: 4.1 trees/ac, 90%CI [1, 7]
	overstory: 124.4 trees/ac, 90%CI [116, 133]	overstory: 38.4 trees/ac, 90%CI [12, 65]	overstory: 28.3 trees/ac, 90%CI [10, 47]
	lg overstory: 46.5 trees/ac, 90%CI [38, 55]	lg overstory: 38.4 trees/ac, 90%CI [27, 49]	lg overstory: 35.4 trees/ac, 90%CI [25, 46]
Average Height to Live Crown (m)	10.0 meters, 90%CI [8.3, 11.8]	23.2 meters, 90%CI [16.3, 30.2]	24.7 meters, 90%CI [18.5, 30.8]
Average Basal Area (sq. ft. /ac)	380.1 ft ² /ac, 90%CI [332.9, 427.2]	266.8 ft ² /ac, 90%CI [192.6, 340.9]	240.6 ft ² /ac, 90%CI [172.6, 308.9]
Average Tonnage of Woody Fuels (tons/acre)	Fine: 4.5 tons/ac, 90%CI [3.4, 5.7]	Fine: 1.9 tons/ac, 90%CI [0.2, 3.5]	Fine: 1.7 tons/ac, 90%CI [0.8, 2.7]
	1000-hr: 13.1 tons/ac, 90%CI [9.7, 16.5]	1000-hr: 19.7 tons/ac, 90%CI [8.6, 30.9]	1000-hr: 21.1 tons/ac, 90%CI [7.1, 35.0]
	Litter/Duff: 29.2 tons/ac, 90%CI [19.0, 39.4]	Litter/Duff: 15.0 tons/ac, 90%CI [2.5, 27.5]	Litter/Duff: 6.8 tons/ac, 90%CI [4.0, 9.5]
	Total: 46.8 tons/ac, 90% CI [32.3, 61.4]	Total: 36.6 tons/ac, 90% CI [4.4, 68.8]	Total: 29.6 tons/ac, 90% CI [6.1, 53.1]
Average Density of Seedlings	424 seedlings/ac, 90%CI [313, 536]	145 seedlings/ac, 90%CI [14.8, 276]	1901 seedlings/ac, 90%CI [1266, 2535]
Average Understory Cover	Native: 27.4%,90%CI [17.4, 37.3]	Native: 5.6%, 90%CI [2.3, 8.8]	Native: 22.1%, 90%CI [13.7, 30.6]
	Non-Native: 0.9%,90%CI [0.4, 1.4]	Non-Native: None Observed	Non-Native: 5.3%, 90%CI [2.5, 8.0]
	Moss: 25.5%,90%CI [11.1, 39.8]	Moss: 2.3%, 90%CI [0.4, 4.1]	Moss: 3.6%, 90%CI [0.9, 6.3]
	Forb/herb: 7.4%, 90% CI [5.1, 9.7]	Forb/herb: 1.7%, 90% CI [0, 3.4]	Forb/ herb: 5.9%, 90% CI [4.2, 7.6]
	Shrub: 16.3%, 90% CI [11.3, 21.3]	Shrub: 3.9%, 90% CI [0, 9.6]	Shrub: 19.7%, 90% CI [14.9, 24.5]

Trees:

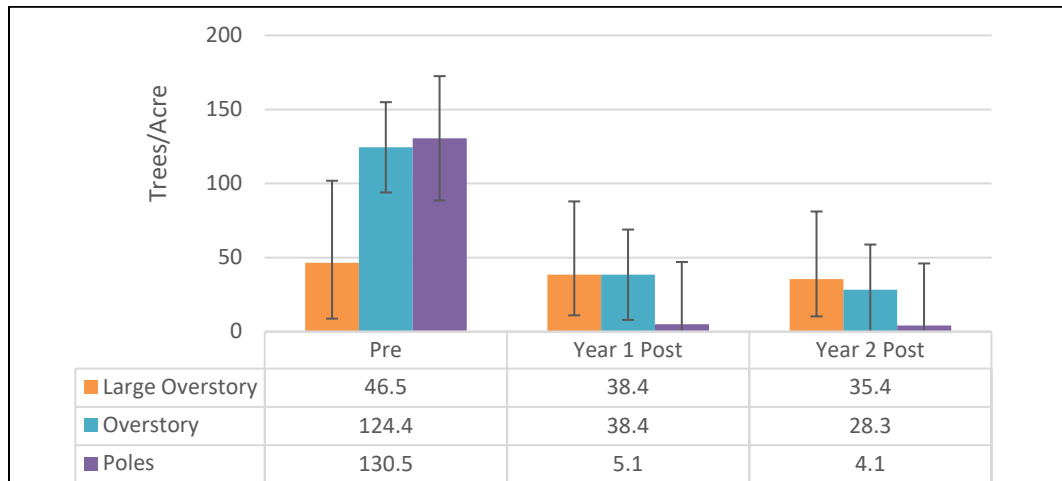


Figure 8. Average live stand density by size class, pre, 1- and 2-years post Sourdough Wildfire in Diablo Unit plots (n=4) with 90% confidence intervals.

The 2023 Sourdough Fire produced moderate to high burn severity within the Diablo Unit. The change in density of live trees indicates a significant decrease in density for both the overstory (15 > 60cm DBH) and pole (2.5 > 15 cm) sized trees in the two years following the fire (Figure 8). The decrease in live large overstory trees (>60cm DBH), however, indicates a decrease in density that is not significant with 46.5 trees/acre pre-fire and 35.4 trees/acre 2 years post-fire. The ability for the large overstory trees to withstand the wildfire contributed to maintaining basal area above 200 ft. sq./ac. following the fire (380 ft.sq./ac pre-fire, 240.6 ft.sq./ac 2-years post) (Table 3). The most common species of overstory trees, 2 years after the Sourdough Wildfire, in order of prevalence are Douglas fir, Western red cedar, and Bigleaf maple.

Seedlings:

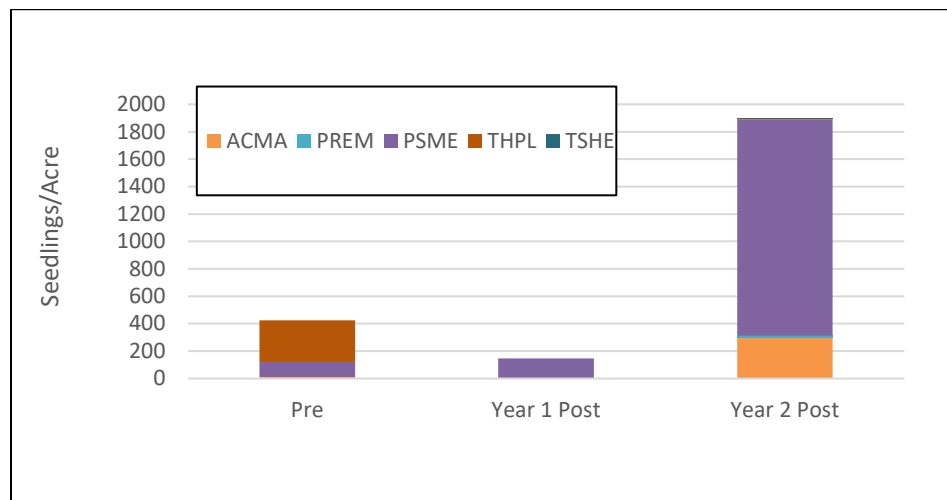


Figure 9. Average seedling density by species, pre, 1- and 2-years post Sourdough wildfire in the Diablo Unit plots (n=4).

The average density of seedlings within the Diablo Unit has increased after the Sourdough Fire, with a pre-fire density of 424 seedlings/ac and a 2-year post fire density of 1901 seedlings/ac (*Figure 9*). Pre-fire, western red cedar demonstrated the highest density of seedlings at 303 seedlings/ac and bigleaf maple demonstrated the lowest density of seedlings at 12.1 seedlings/ac. 1-year post fire, the only seedlings observed were Douglas fir seedlings at 145.6 seedlings/ac. 2-years post fire, Douglas fir demonstrated the highest density of seedlings (1577.6 seedlings/ac). 2-years post fire, bigleaf maple (295.3 seedlings/ac), western red cedar and western hemlock seedlings were present but observed at relatively low densities.

Height to Live Crown:

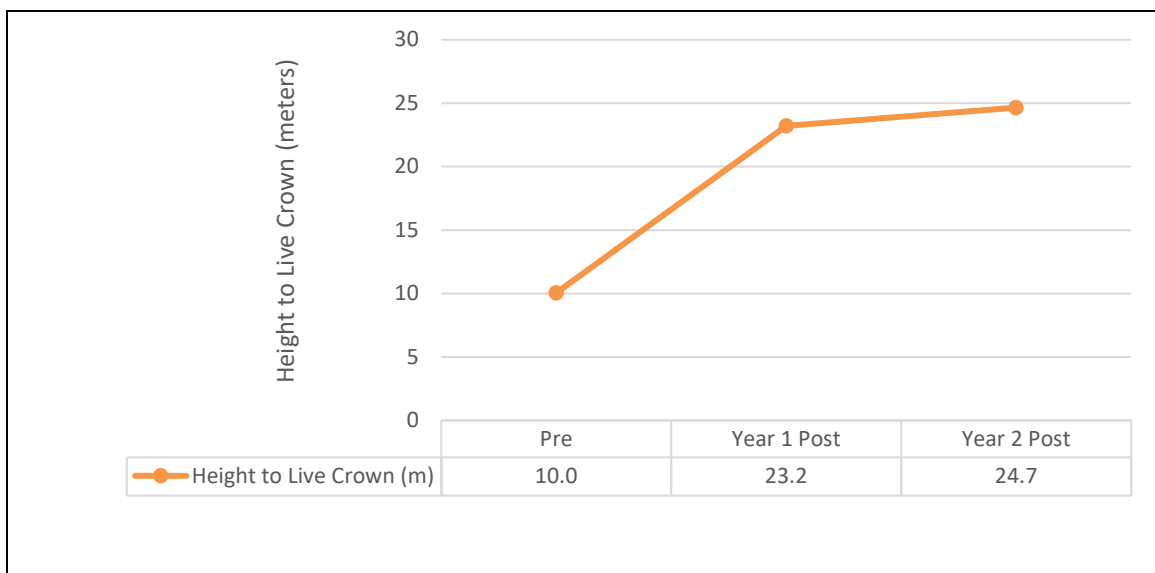


Figure 10. Height to live crown (meters), pre, 1- and 2-years post Sourdough Wildfire in Diablo Unit plots (n=4).

Average height to live crown within the Diablo Unit has increased from 10 meters to 23.2 meters 1-year post Sourdough Wildfire and has continued to increase to 24.7 meters, 2-years post Sourdough Wildfire (*Figure 10*).

Fuels:

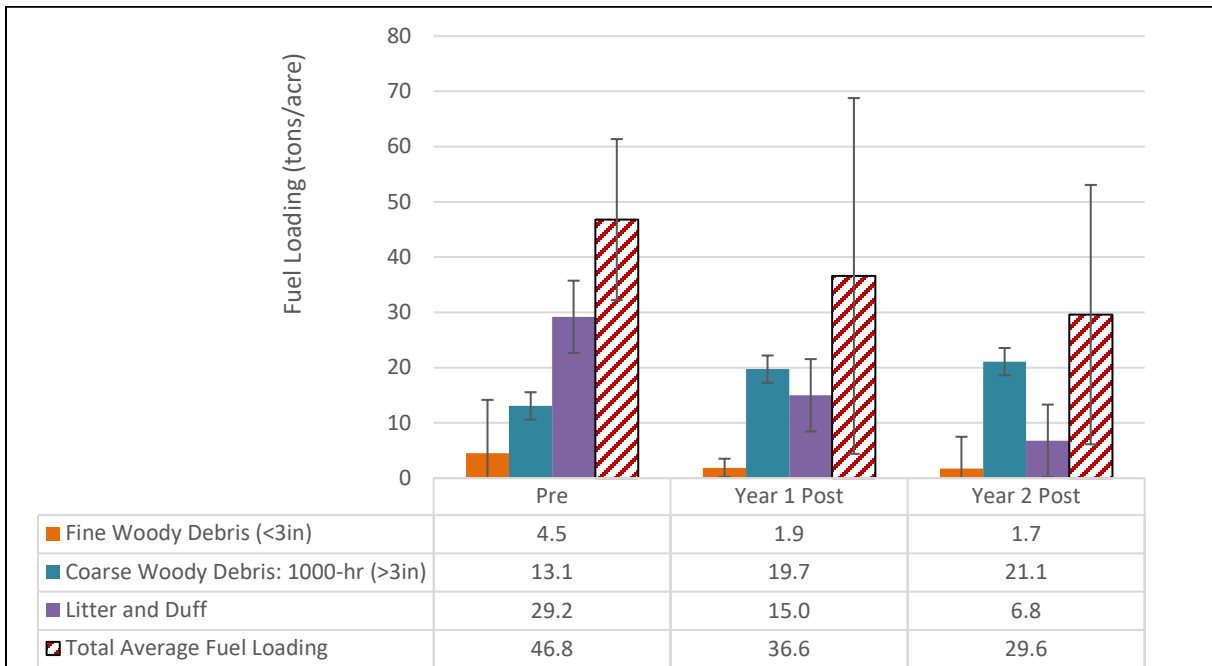


Figure 11. Average fuel loading by size class, pre- 1-, and 2-years post Sourdough Wildfire in the Diablo Unit plots (n=4) with 90% confidence intervals.

Following the Sourdough Fire, both fine woody fuels and litter and duff decreased in the average tons/acre (Figure 11). 1000-hour coarse woody debris increased in tonnage/acre in the two years following the wildfire, most likely due to fallen tree boles.

Understory Cover:

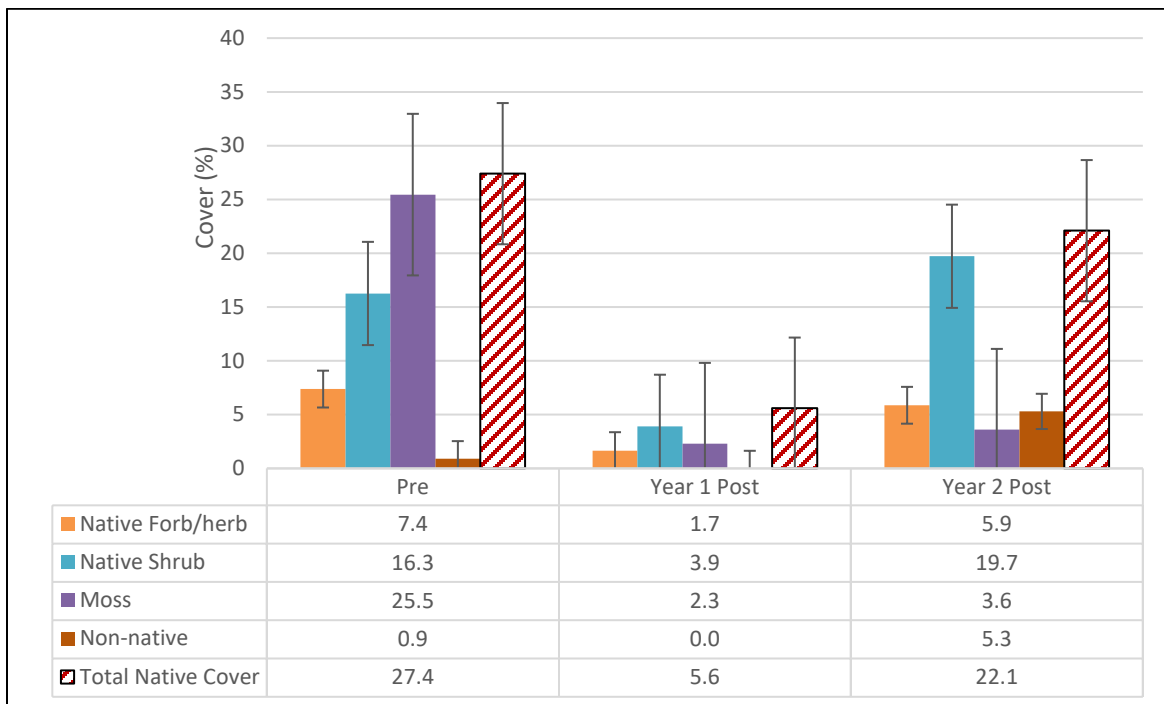


Figure 12. Average understory cover by lifeform. Pre, 1- and 2- years post Sourdough Wildfire in the Diablo Unit plots (n=4) with 90% confidence intervals.

Understory cover decreased by all vegetation types one year following the wildfire, however two years post-fire shrub cover increased to a level greater than its pre-fire state, and forb and moss cover increased from 1 year post to 2 years post (Figure 12). Total native cover includes cover of forbs/herbs, shrubs, and graminoids, however, no graminoids were found within the plots. Moss is not included in estimate of total native understory cover.

Non-native species were present at a low level in the pre-dataset (0.9%) and increased to 5.3% 2 years post fire. Only two species of non-natives were observed in the Diablo unit 2-years post fire: Common Mullein (*Verbascum Thapsus*) and Wall Lettuce (*Mycelis muralis*).



Figure 13. Diablo Unit Plot 3: Pre (top), Year-1 Post Wildfire (middle), Year-2 Post Wildfire (bottom).



Figure 14. Diablo Unit Plot 3: Pre (top), Year-1 Post Wildfire (middle), Year-2 Post Wildfire (bottom).

Management Recommendations:

These Westside FMH monitoring results will be utilized to develop customized fuels management treatment objectives and prescriptions for the tapered treatment areas in NOCA. The overriding management goal for these units is not to stop a fire via a firebreak but to decrease fire intensity in these areas by fostering conditions which favor surface fire (rather than crown fire) during a wildfire. In doing so, it is anticipated that both the amount of time available for the public to egress from these areas and the probability of successful defensive burnout operations will be augmented.

Fire intensity modeling conducted by USFS Research Fire Ecologist, Morris Johnson, which incorporated pre-fire monitoring data for the NOCA Westside Units, indicates that reducing overstory tree density from current stocking levels down to 25-50 trees/per acre would be most effective at shifting fire behavior from active, passive, and crown fire to surface fire.

The following monitoring results may prove particularly useful points in the development of Tapered Treatment objectives and prescriptions within the Westside Units:

- Pre-treatment average tree density by size class by unit.
- Pre-treatment average height to live crown by unit
- Pre-treatment average fuel loading by size class by unit
- Comparison of pre- and two-year post-fire average tree density by size class for the Sourdough Unit
- Comparison of pre- and two-year post-fire average height to live crown by size class for the Sourdough Unit
- Comparison of pre- and two-year post-fuel loading by size class for the Sourdough Unit

In addition to reducing overstory tree density, it is recommended that fuels treatments for fire management objectives incorporate the following components:

- Thin from below with an emphasis on:
 - Removal of poles and smaller diameter trees
 - Begin by thinning out smallest diameter trees and working up in size until tree density objectives are achieved (or approached) as appropriate
 - Limit understory thinning to a maximum dbh threshold
 - Removing large diameter trees will substantially increase surface fuel loading levels and increase overall fire intensity
 - Removal of coniferous ladder fuels
 - Increasing height to live canopy
- Maintain overstory canopy closure to retain understory vegetation and fuel moisture, minimize understory vegetation cover and decrease surface wind intensity. Continuous canopy cover is typical of Westside Cascade temperate forests.
- Dispose of redistributed and pre-existing woody surface fuels via pile burning rather than broadcast burning
- Limit snag removal to one- and one-half tree lengths from potential control/firing lines
- Establish a schedule of periodic maintenance treatments following the initial treatment as informed by a regular schedule of post-treatment monitoring results following standard FMH monitoring timeframes and methodologies.

- Pre- and post-treatment estimations of canopy closure should be added to the monitoring protocol

Although the tapered treatment areas are not intended as ecological restoration treatments, the following components may be integrated, as feasible, to support wildlife habitat considerations and to emulate natural conditions.

- Retain large diameter trees and trees with advantageous nesting and habitat features
- Retain surface large woody debris as feasible
- Maintain overstory canopy closure
- As feasible with fire management objectives:
 - Maintain isolated clumps of understory trees to foster periodic multi-story understory canopy and benefit wildlife travel corridors
 - Retain deciduous trees as feasible
 - Deciduous trees tend to be less effective as ladder fuels through thick moss layers on boles and branches may carry fire into the canopy
 - Minimize the removal of snags

To avoid the establishment and spread of invasive species the following components should be considered:

- Minimize ground disturbance
- Maintain overstory canopy closure to maintain native understory vegetation
- Conduct fuels treatment work manually rather than with heavy equipment
- Monitor and treatment areas for invasive species infestations and communicate findings to network IPMT Manager.

The objectives and prescriptions for the ELC Transmission Line Unit will vary substantially from the other Westside Units due to unique objectives associated with maintaining safe vegetation clearance distances from the transmission line to minimize the potential of electrical arcing from vegetation or from smoke and fire during a wildfire.

Due to more mesic climatic conditions and high fuel loading associated with deep litter and duff layers, the Hozomeen Unit may value from broadcast prescribed burning once initial fire management objectives have been met through pile burning strategies.

It is advised that a collaborative approach incorporating the NOCA Fire Ecologist, NOCA Fuels Specialist, NOCA Wildlife Biologist, and a forester be employed to develop site-specific fuels treatment objectives and prescriptions by tapered treatment unit. Treated areas should be regularly monitored following standard FMH post-thinning and prescribed burning protocols.

NOCA Contour Units: Effects of Two Wildfire Events in Open Versus Closed Canopy Mixed Conifer Forest in the Stehekin Valley

The Stehekin Valley, situated along the southern flank of the North Cascades National Park Complex, is located within a transitional zone between the mixed conifer forests typical of the western slope of the Cascade Mountains and the ponderosa pine dominated forests along the range's lower elevation, eastern slopes. In 2006 and 2009, the NPCB fire Effects Crew installed 19 plots along the mid-elevation valley walls ("Contour Units") in the Stehekin Valley. These units consisted of two different monitoring types: "Open Canopy Mixed Conifer" and "Mid-Closed Canopy Mixed Conifer" (Figure 15). Of the 19 plots established, 8 plots met the criteria of mid to closed canopy and 11 plots met the criteria of open canopy.

Open Canopy Mixed Conifer: Mixed conifer forest dominated by ponderosa pine (*Pinus ponderosa*) (10-30%), with or without a significant component of Douglas Fir (*Pseudotsuga menziesii*) (0-30% cover), and **with a total canopy cover of no more than 40%**. Open grass-dominated areas with widely spaced ponderosa overstory, which integrate into denser overstory are included. The variable understory includes grasses/ forbs (20-40% cover).

Mid-Closed Canopy Mixed Conifer: Primarily dominated by Douglas fir (*Pseudotsuga menziesii*) (30-100% cover), with or without a significant component of ponderosa pine (*Pinus ponderosa*) (0-50%) **with a total canopy cover of 40 to 100%**. Mid-canopy areas may include gaps, but not those which produce distinct "edge" vegetation. Additional tree species may be present, such as aspen (*Populus tremuloides*), black cottonwood (*Populus trichocarpa*), red alder (*Alnus rubra*), dogwood (*Corus nuttallii*), Douglas maple (*Acer glabrum* var. *douglasii*), and bigleaf maple (*Acer macrophyllum*), but should not constitute more than **20%** of the canopy. This monitoring type may range from little to no understory vegetation when a heavy litter and duff component is present or may have a variable understory comprised of grasses/ forbs (20-90% cover).

Figure 15. Ecological descriptions of Open Canopy Mixed Conifer and Mid-Closed Canopy Mixed Conifer monitoring types.

The original intent for establishing plots within the Contour Units was to monitor these units in anticipation of landscape-scale prescribed fire treatments along the forested hillsides of the Stehekin Valley. Although such treatments were later determined to be unsuitable, the area subsequently experienced two wildfires after the plots were installed. The 2010 Rainbow Bridge Fire burned 11 of the 19 plots and the 2024 Pioneer Fire burned 5 plots, 4 of which had burned previously in the Rainbow Bridge Fire (Figure 16). Monitoring data was collected prior to all wildfires ("Pre" reads) and one year following each of the two wildfires ("1-Year Post" reads). No fuels treatments have occurred in any of these units.

Analysis of fire effects following both singular and reburn wildfire events offers insights as to how open and mid-closed canopy mixed-conifer forest along the steep slopes of the Stehekin Valley respond to wildfire. Understanding post-fire responses in these areas may prove useful in anticipating future fire effects during similar events and in informing management decisions associated with wildfire suppression strategy and tactics.

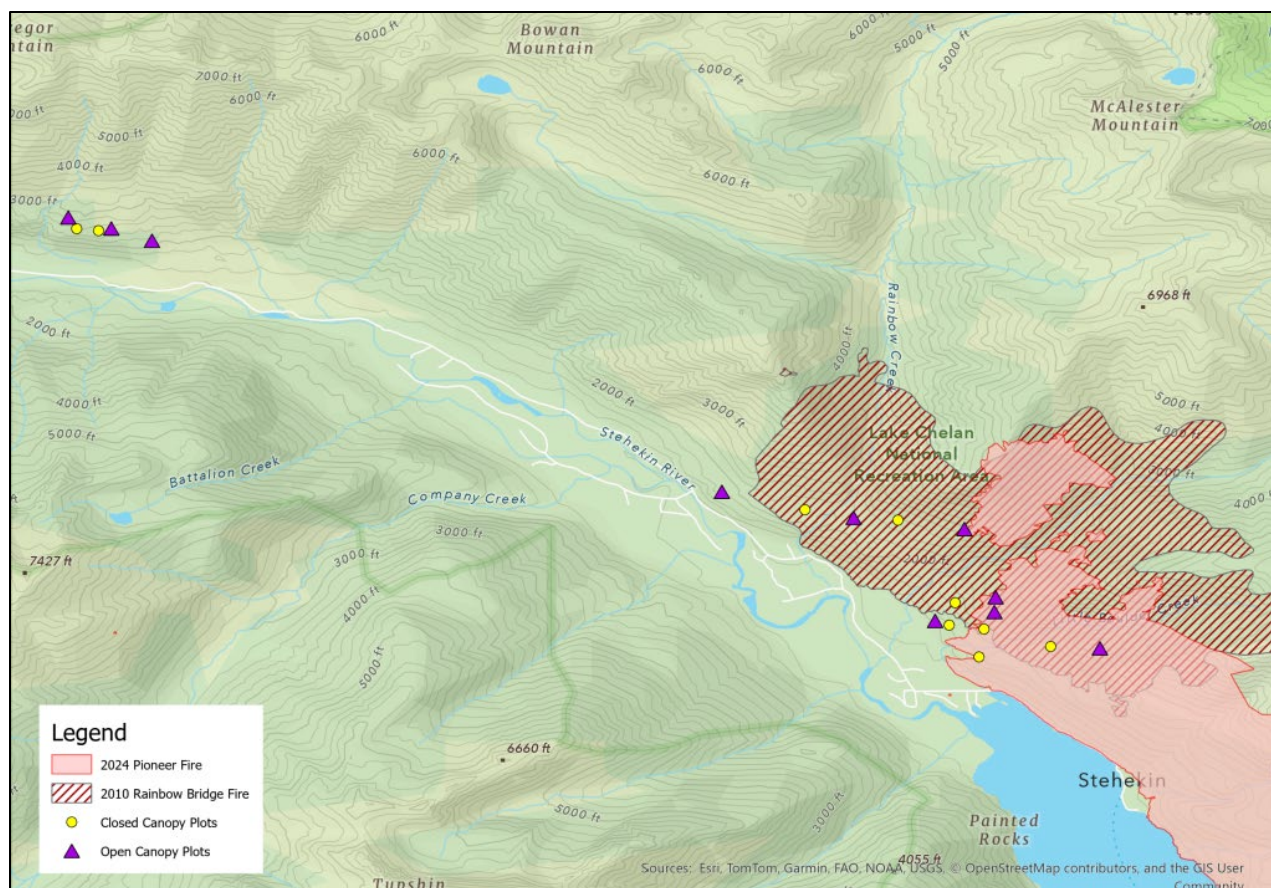


Figure 16. Map showing locations of Contour Unit plots and canopy cover classification.

Table 4. Contour Unit Monitoring Results: Pre-, Post First-, and Post Second-Wildfire

Monitoring Unit	Monitoring Indicators	Monitoring Results [90 % Confidence Interval]		
		Pre-Fire	1 Year Post 1 st Wildfire	1 Year Post 2 nd Wildfire
Contour Unit - Open Canopy Mixed Conifer Pre - 8 plots 1 Year Post 1st WF - 5 plots 1 Year Post 2 nd WF - 2 plots	poles = 2.5cm > 15 cm DBH, overstory: 15 cm > 60 cm DBH, lg overstory: 60 > max DBH			
	Average Density of Live Trees	poles: 27.6 trees/ac, 90%CI [8.5, 46.7]	poles: 2.0 trees/ac, 90%CI [0, 4.4]	poles: None Observed
		overstory: 39.4 trees/ac, 90%CI [25.9, 52.9]	overstory: 8.1 trees/ac, 90%CI [2.1, 14.1]	overstory: 6.1 trees/ac, 90%CI [0, 83.2]
		lg overstory: 10.7 trees/ac, 90%CI [3.6, 17.7]	lg overstory: 2.7 trees/ac, 90%CI [0, 8.7]	lg overstory: 2.0 trees/ac, 90%CI [0, 27.8]
	Average Height to Live Crown	4.7 meters, 90%CI [3.8, 5.7]	4.7 meters, 90%CI [0, 10.5]	4.8 meters, 90%CI [0, 12.7]
	Average Basal Area	113.9 sq. ft/ac, 90%CI [84.9, 142.8]	42.2 sq. ft/ac, 90%CI [8.7, 75.7]	33.7 sq. ft/ac, 90%CI [0, 89.1]
		Fine: 2.2 tons/ac, 90%CI [1.5, 2.9]	Fine: 0.6 tons/ac, 90%CI [0.3, 0.9]	Fine: 0.9 tons/ac, 90%CI [0, 1.8]

	Average Tonnage of Woody Fuels	1000-hr: 7.3 tons/ac, 90%CI [3.7, 10.9] Litter & Duff: 22.9 tons/ac, 90%CI [14.4, 31.5] Total: 41.7 tons/ac, 90% CI [35.9, 47.5]	1000-hr: 3.45 tons/ac, 90%CI [0.3, 6.6] Litter & Duff: 2.4 tons/ac, 90%CI [0.7, 4.1] Total: 7.8 tons/ac, 90% CI [1.1, 14]	1000-hr: 13.7 tons/ac, 90%CI [0, 34.0] Litter & Duff: 4.51 tons/ac, 90%CI [3.7, 5.3] Total: 16.4 tons/ac, 90% CI [8.7, 24.2]
	Average Density of Seedlings	49.9 seedlings/ac, 90%CI [15.4, 84.3]	29.7 seedlings/ac, 90%CI [0, 59.5]	28.3 seedlings/ac, 90%CI [0, 61.6]
	Average Understory Cover	Native: 67.5%, 90%CI [54.0, 81.0] Non-Native: 0.7%, 90%CI [0.1, 1.4] Native Forbs: 8.8%, 90% CI [3.3, 14.4] Native Graminoid: 36.5%, 90% CI [27.9, 45.1] Native Shrub: 15.5%, 90% CI [10.5, 20.5]	Native: 28.7%, 90%CI [14.8, 42.7] Non-Native: 0.1%, 90%CI [0, 0.3] Native Forbs: 8.2%, 90% CI [2.9, 13.6] Native Graminoid: 15.3%, 90% CI [6.5, 24.1] Native Shrub: 5.1%, 90% CI [1.9, 8.3]	Native: 52.2%, 90%CI [38.6, 65.9] Non-Native: 6.6%, 90%CI [2.7, 10.6] Native Forbs: 14.4%, 90% CI [8.0, 20.9] Native Graminoid: 23.6%, 90% CI [14.5, 32.8] Native Shrub: 13.6%, 90% CI [2.1, 25]
Monitoring Unit	Monitoring Indicators	Monitoring Results [90 % Confidence Interval]		
		Pre-Fire	1 Year Post 1 st Wildfire	1 Year Post 2 nd Wildfire
Contour Unit – Mid-Closed Canopy Mixed Conifer Pre - 11 plots 1 Year Post 1 st WF – 6 plots 1 Year Post 2 nd WF – 2 plots	poles = 2.5cm > 15 cm DBH, overstory: 15 cm > 60 cm DBH, lg overstory: 60 > max DBH			
	Average Density of Live Trees	poles: 67.3 trees/ac, 90%CI [30.8, 103.7] overstory: 148.2 trees/ac, 90%CI [107.0, 189.4] lg overstory: 17.7 trees/ac, 90%CI [6.3, 29.1]	poles: 8.9 trees/ac, 90%CI [0, 25.7] overstory: 32.4 trees/ac, 90%CI [0, 102.3] lg overstory: 10.5 trees/ac, 90%CI [0, 22.6]	poles: None Observed overstory: 6.1 trees/ac, 90%CI [0, 16.7] lg overstory: 2.0 trees/ac, 90%CI [0, 27.8]
	Average Height to Live Crown	14.7 meters, 90%CI [9.0, 20.3]	9.9 meters, 90%CI [2.1, 17.7]	13.5 meters, 90%CI [0, 25.8]
	Average Basal Area	229 sq. ft. /ac, 90%CI [198.6, 259.4]	104.6 sq. ft. /ac, 90%CI [19.2, 190.1]	25.0 sq. ft. /ac, 90%CI [0, 66.1]
	Average Tonnage of Woody Fuels	Fine: 5.6 tons/ac 90%CI [3.7, 7.5] 1000-hr: 6.5 tons/ac, 90%CI [3.6, 9.3] Litter & Duff: 34.5 tons/ac, 90%CI [31.9, 37.1] Total: 35.7 tons/ac, 90% CI [27.8, 43.6]	Fine: 0.5 tons/ac, 90%CI [0.2, 0.8] 1000-hr: 3.4 tons/ac, 90%CI [0, 7.0] Litter & Duff: 3.9 tons/ac, 90%CI [1.8, 5.9] Total: 7.8 tons/ac, 90% CI [4.0, 11.4]	Fine: 0.4 tons/ac, 90%CI [0.2, 0.7] 1000-hr: 12.5 tons/ac, 90%CI [5.0, 20.0] Litter & Duff: 3.47 tons/ac, 90%CI [0, 8.7] Total: 19.0 tons/ac, 90% CI [0, 39.6]
	Average Density of Seedlings	236 seedlings/ac, 90%CI [109.3, 364.0]	141 seedlings/ac, 90%CI [102.9, 180.3]	1957 seedlings/ac, 90%CI [0, 4905.0]
	Average Understory Cover	Native: 30.2%, 90%CI [14.3, 46.1] Non-Native: 0.2%, 90%CI [0, 0.5] Native Forb: 4.2%, 90% CI [2.6, 5.8] Native Graminoid: 14.6%, 90% CI [4.5, 24.7] Native Shrub: 14.4%, 90% CI [3.6, 25.1]	Native: 12.9%, 90%CI [2.1, 23.7] Non-Native: None observed Native Forb: 3.3%, 90% CI [1.9, 4.8] Native Graminoid: 8.8%, 90% CI [3.3, 14.3] Native Shrub: 3.3%, 90% CI [0, 6.3]	Native: 35.5%, 90%CI [11.8, 59.3] Non-Native: None observed Native Forb: 22.7%, 90% CI [4.7, 40.8] Native Graminoid: 5.4%, 90% CI [0, 13.3] Native Shrub: 5.7%, 90% CI [4.2, 7.3]

Trees

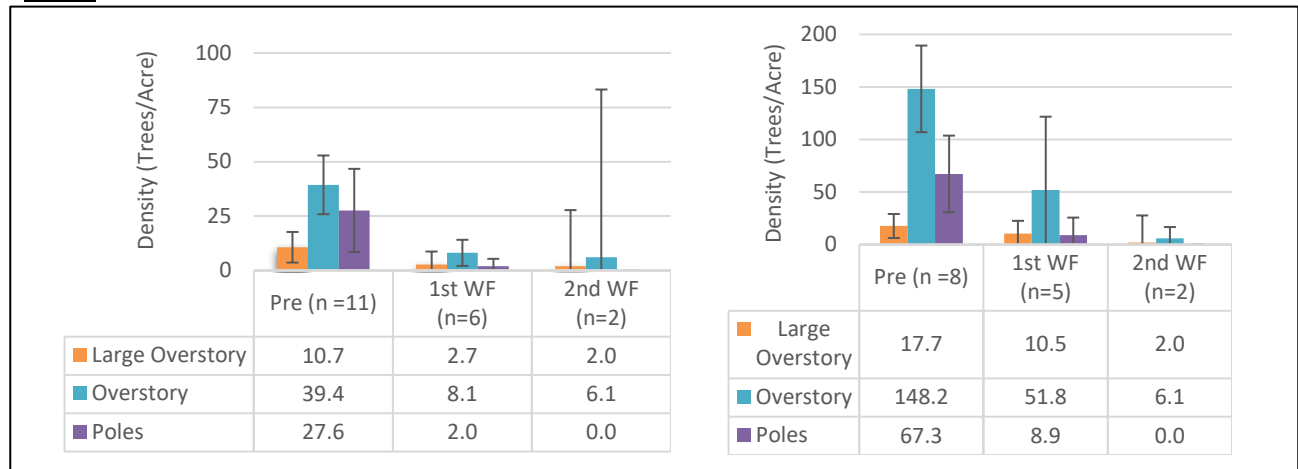


Figure 17. Left: Open canopy tree densities following first and wildfires. Right: Mid-Closed canopy tree densities following first and second wildfires.

Tree densities within the Contour Units decreased significantly following the first wildfire and then continued to decrease after the second wildfire 14 years later (*Figure 17*). Closed canopy plots initially had more trees per acre in all size classes, but following two wildfires both canopy types demonstrated similar estimated average density for all size classes. Plots originally classified as mid-closed canopy now exhibit tree densities resembling the open canopy plots.

Fuels

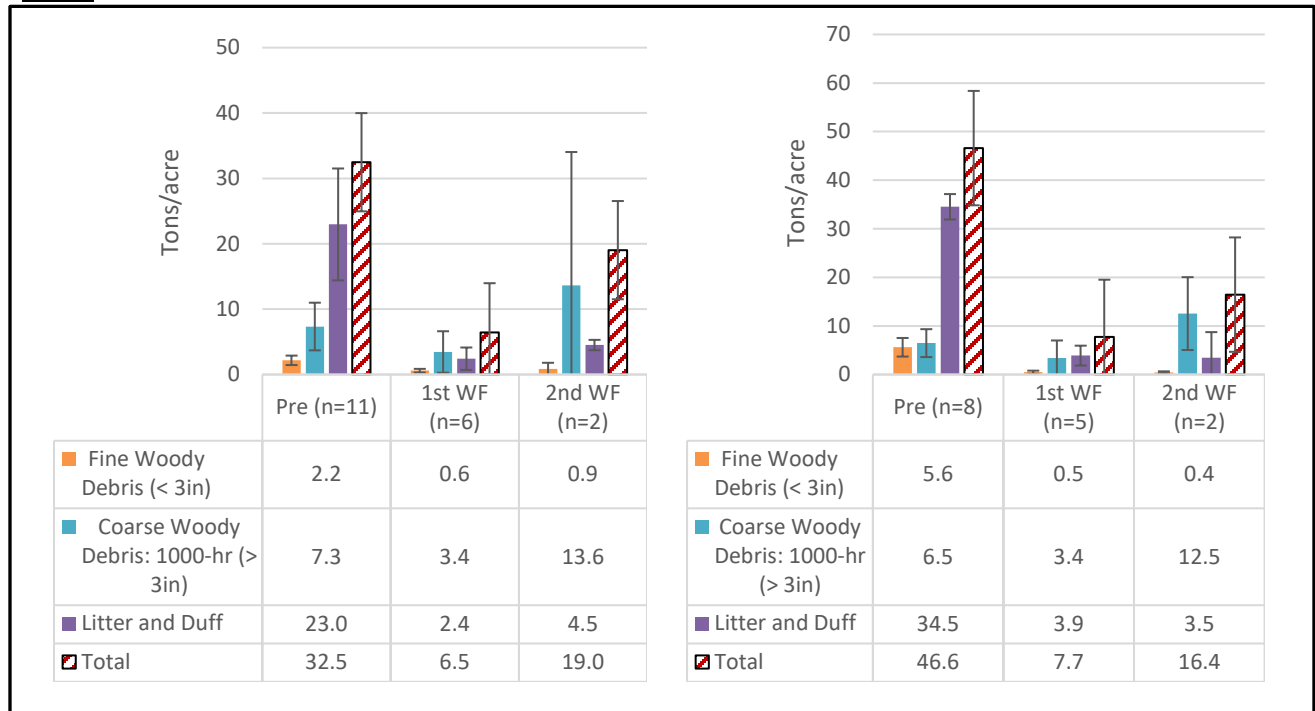


Figure 18. Left: Open Canopy average cover by lifeform following first and second wildfire. Right: Mid-Closed canopy average cover by lifeform following first and second wildfire.

Fuels within both monitoring types followed similar trends and average fuel loading despite difference in pre-fire canopy cover (Figure 18). Canopy cover exhibited little effect on the average tonnage of fuel loading present following both wildfires. Coarse woody debris within both canopy types increased from pre- and post-1st wildfire levels following the second wildfire. The increase in coarse woody debris, although not significant, is likely due to once standing live trees falling to the ground. Conditions one year following the second wildfire, as compared to the initial pre-fire state indicate significant changes in litter and duff measurements. Average litter and duff tonnage across all contour units averages approximately 4 tons/ac following both wildfires as compared to 28.8 tons/acre prior to the initial burn.

Understory Cover:

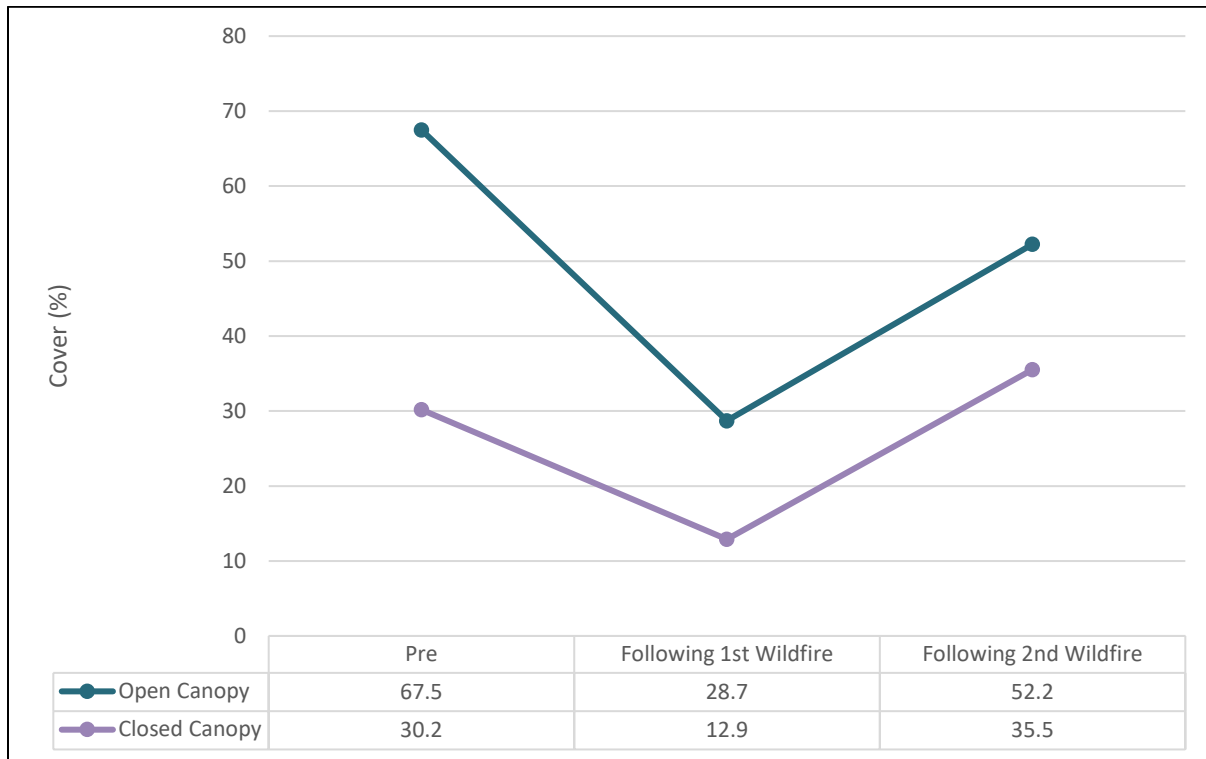


Figure 19. Comparison of total, native understory total cover in open versus closed canopy following two wildfire events.

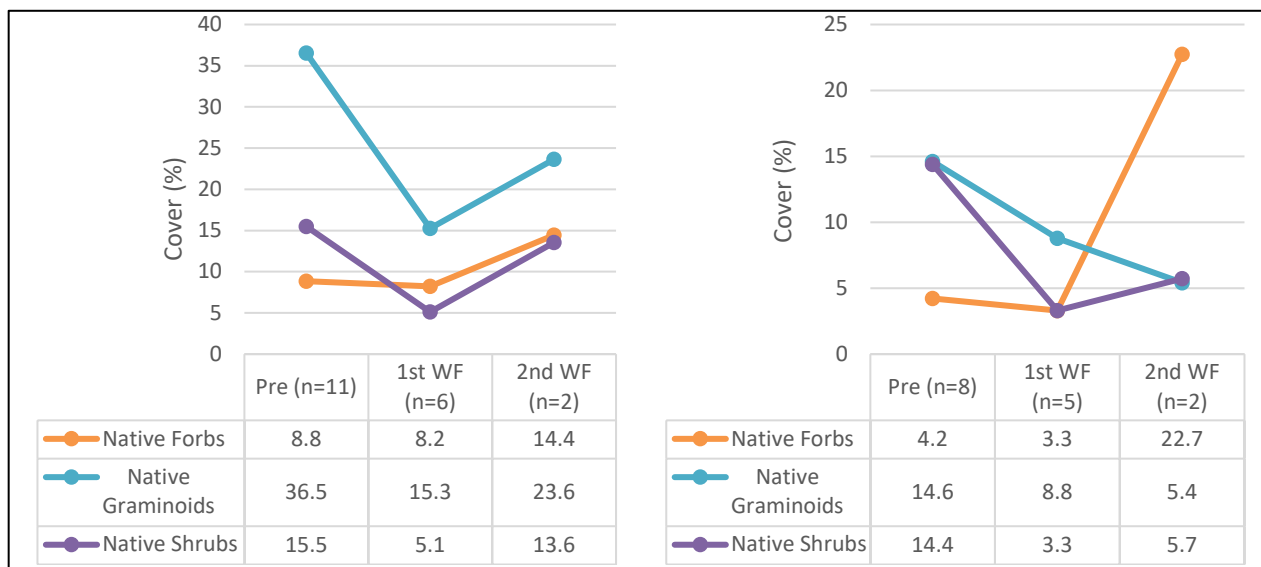


Figure 20. Left: Open canopy native understory cover by lifeform following first and second wildfire. Right: Closed canopy native understory cover by lifeform following first and second wildfire.

Changes to understory cover in the Contour Units demonstrate similar overall trends in both the open and mid-closed canopies (*Figure 20*). Both canopy types demonstrated a decrease in cover following the first wildfire followed by increased cover following the second wildfire. Initially, the mid-closed canopy had around 14.5% cover of both native graminoids and native shrubs, and only about 4.2% cover of native forbs. In 2025, native shrubs and grasses support around 5.5%, while forb cover has increased to 22.7%. In the open canopy, each lifeform exhibited similar trends, graminoids have maintained the most dominant cover, 36.5% pre, and 23.6% after the second wildfire. After the first wildfire, shrubs showed a decrease in cover, going from 15.5% to 5.1%, but have increased in cover after the second wildfire to 13.6%. Total native cover includes cover of forbs/herbs, shrubs, and graminoids. Moss is not included in estimate of total native understory cover.

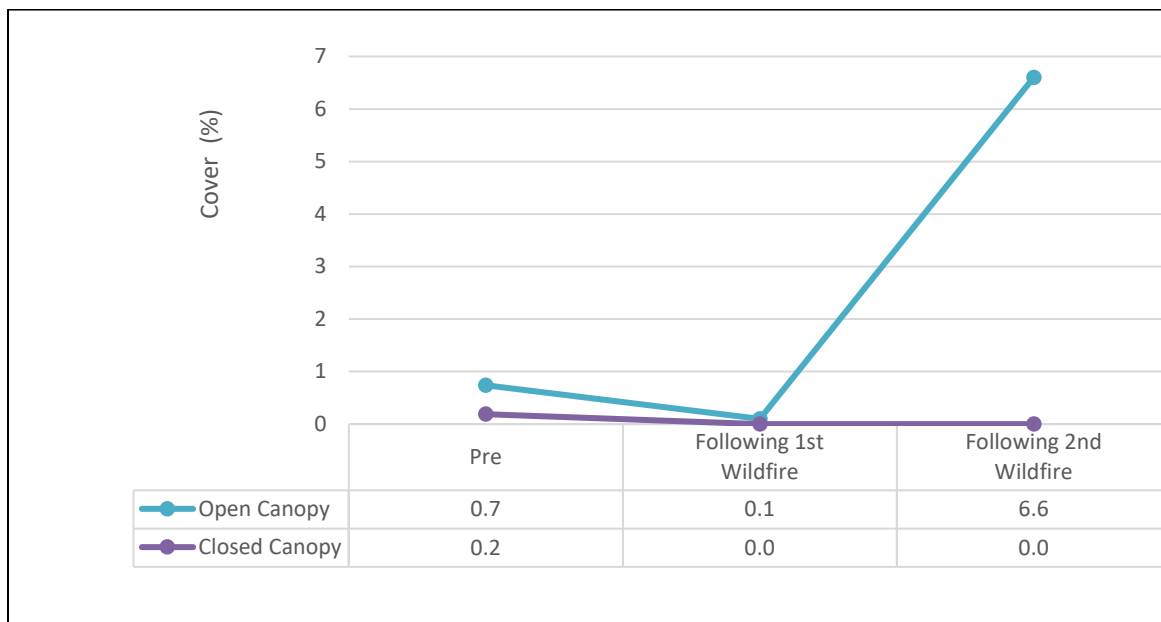


Figure 21. Comparison of non-native, understory species total cover in open versus mid-closed canopy following two wildfire events.

Non-native species cover in the Contour Units have remained relatively low even following the second wildfire (*Figure 21*). The open canopy units demonstrated a higher cover of invasive species following the second wildfire (7%) as compared to the closed canopy (0%). Increases in non-native cover did not become evident in the open canopy type until after the second wildfire. The most notable non-native species found throughout the Contour Units, following the second wildfire, were Cheatgrass (*Bromus tectorum*), and common dandelion (*Taraxacum officinale*).

As indicated by post-fire Composite Burn Index (CBI) sampling conducted by the NPCB Fire Effects Monitoring Crew, both canopy types in both wildfires burned on average with moderate burn severity though individual plots ranged from low burn severity to high burn severity (*Table 5*).

Table 5. CBI Burn Severity Ratings by Monitoring Type

CBI Rating	Burn Severity
0.0 – 0.4	no/minimal effect
0.5 – 1.4	low burn severity
1.5 – 2.4	moderate burn severity
2.5 – 3.0	high burn severity

Plot	Monitoring Type	Rainbow Bridge Fire CBI Score	Pioneer Fire CBI Score
FPSME4-03	Mid-Closed Canopy	3	2.2
FPSME4-05	Mid-Closed Canopy	n/a (outside of fire boundary)	1.9
FPSME4-06	Mid-Closed Canopy	1.8	n/a (outside of fire boundary)
FPSME4-11	Mid-Closed Canopy	1	n/a (outside of fire boundary)
FPSME4-15	Mid-Closed Canopy	2.2	2.1
FPSME5-08	Open Canopy	2.9	n/a (outside of fire boundary)
FPSME5-10	Open Canopy	1.9	1.5
FPSME5-17	Open Canopy	2.5	1.5
COMBINED AVERAGE		2.2	1.8

Monitoring Type	Status	CBI Average	Range	Number of Plots
Open Canopy	Following 1 st Wildfire	2.4	1.9 – 2.9	3
Open Canopy	Following 2 nd Wildfire	1.5	1.5 – 1.5	2
Mid-Closed Canopy	Following 1 st Wildfire	2.0	1.0 – 3.0	4
Mid-Closed Canopy	Following 2 nd Wildfire	2.1	1.9 – 2.2	3



Figure 22. Mid and Closed Canopy Mixed Conifer Unit plot pre-wildfire (top). 1-year post-1st wildfire (middle). 1-year post-2nd wildfire (bottom).



Figure 23. Open Canopy Mixed Conifer Unit plot pre-wildfire (top), 1-year post-1st wildfire (middle), 1-year post-2nd wildfire (bottom).

Management Recommendations:

Studying post-fire effects resulting from singular and reburn wildfire events along the steep slopes of the Stehekin Valley provides valuable information as to how open and mid-closed canopy mixed-conifer forests in this area respond to wildfire. Recognizing such trends may prove useful in anticipating future fire effects during similar events in these areas in the future.

Thus said, the following insights should be reflected upon with consideration of the small sample size associated with this analysis,

Trees

- The density of all size classes of live trees (large overstory, overstory, and poles) for both canopy types decreased following the first wildfire and these decreases continued following the second wildfire.
- Live large overstory and overstory trees were still present, although greatly reduced, in both canopy types following the second fire.
- Mid-closed canopy forest lost a greater percentage of live overstory and large overstory trees than open canopy forest.
- By the second wildfire, the density of live trees by size class were equivalent irrespective of pre-fire canopy closure.
- By the second wildfire, all pole-sized trees had been killed in both canopy types.

Fuels

- Total fuel loading in both open and mid-closed canopy types decreased substantially following the first wildfire but then increased following the second wildfire. This increase was due from increased coarse woody debris (> 3 in. diameter) generated from falling snags and branches.

Understory Vegetation

- Understory vegetation cover as viewed collectively among both canopy types one year following the second wildfire (43.9%) approximated pre-fire cover (48.9%).
- For both open and mid-closed canopy, forb cover surpassed pre-fire conditions following the second wildfire, whereas native graminoids and native shrubs both decreased in cover.
- Non-native species cover remained consistently low in the mid-closed canopy forest type even following the second wildfire.

- Non-native cover (particularly cheat grass and common dandelion) increased substantially (943% increase) in open canopy forest. This increase was only evident following the second wildfire.

NOCA 2024 Pioneer and Ruby Fire Composite Burn Index: Ground-truthing Burn Severity Satellite Imagery

2024 Pioneer Fire

The Pioneer Fire ignited by human causes on June 8, 2024, along the shore of Lake Chelan near the town of Stehekin, WA. The fire burned approximately 39,000 acres, of which 7,471 acres were situated on NPS lands. The area in which the Pioneer Fire burned within NOCA is dominated by ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Psuedotsuga menzessii*) at lower elevations and whitebark pine (*Pinus albicaulis*) and subapline fire (*Abies lasiocarpa*) at higher elevations.

In the summer of 2025, the NPCB fire effects crew collected Composite Burn Index (CBI) data within the Pioneer Fire burn scar to ground truth and calibrate remotely sensed burn severity imagery provided by the Monitoring Trends in Burn Severity (MTBS) program. 41 CBI locations were sampled, 5 of which were co-located with the origin of previously established FMH plots. MTBS burn severity imagery was created from comparing Landsat satellite imagery pre- and 1-year post-fire. Field-collected CBI data was used to ground truth and recalibrate the MTBS burn severity map in order to more accurately illustrate the true nature of burn severity across the area burned by the Pioneer Fire on NPS lands.

To correspond with one pixel of imagery, field data was collected using 15m radius circular plots. At each plot, a burn severity rating (ranging from 0.0 – 3.0) was ocularly estimated for different strata of vegetation and fuels (substrate, understory, intermediate trees, and overstory trees). These ratings were then averaged to calculate an average total burn severity for the entire plot.

A total of 41 CBI plots were sampled within a variety of burn severities and elevations

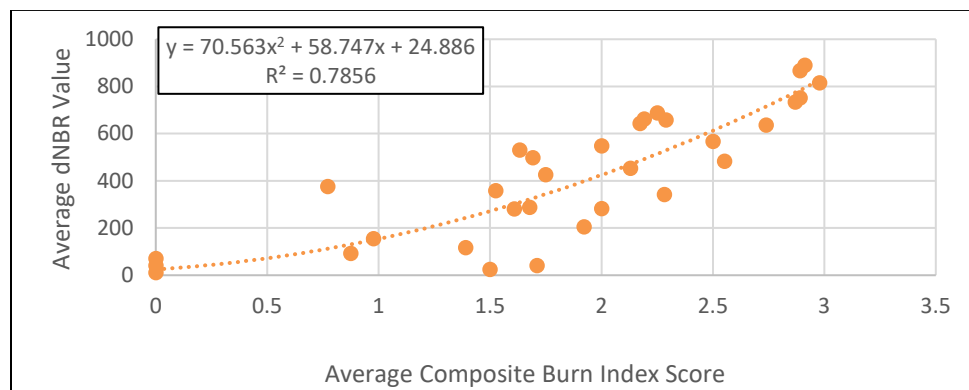


Figure 24. Regression analysis for average CBI score and average dNBR for each CBI plot for the Pioneer Fire.

CBI-determined difference normalized burn ratio (dNBR) thresholds were calculated utilizing CBI threshold baselines as identified in Miller and Thode (2007) in conjunction with the trendline expression (Figure 24). The thresholds calculated from field-derived CBI data specific

to the Pioneer Fire indicate a smaller range of values for the unburned and low severity classes and a larger range of dNBR values for moderate and high severity classes.

The dNBR values estimate the absolute magnitude of change to vegetation and soil strata pre- and post-fire based on reflectance imagery (Miller and Thode, 2007). For example, areas of high burn severity will demonstrate a large change in dNBR values because the imagery will indicate a high degree of reflectance as compared pre- and post-fire.

Table 6. dNBR Burn Severity Thresholds for the Pioneer Fire

Burn Severity	MTBS dNBR thresholds		CBI determined dNBR Thresholds	
	Low End	High End	Low End	High End
 Unburned	Min	80	Min	31.5
 Low	81	324	31.5	208.6
 Moderate	325	600	208.6	514.3
 High	600	Max	514.3	max

Table 7. Total Acres burned by Burn Severity Classification based on MTBS Thresholds and CBI Thresholds of dNBR Reflectance

Burn Severity	Total Acreage	
	MTBS Classified	CBI Classified
 Unburned	5684	4149
 Low	19059	12540
 Moderate	8848	14713
 High	1917	4106

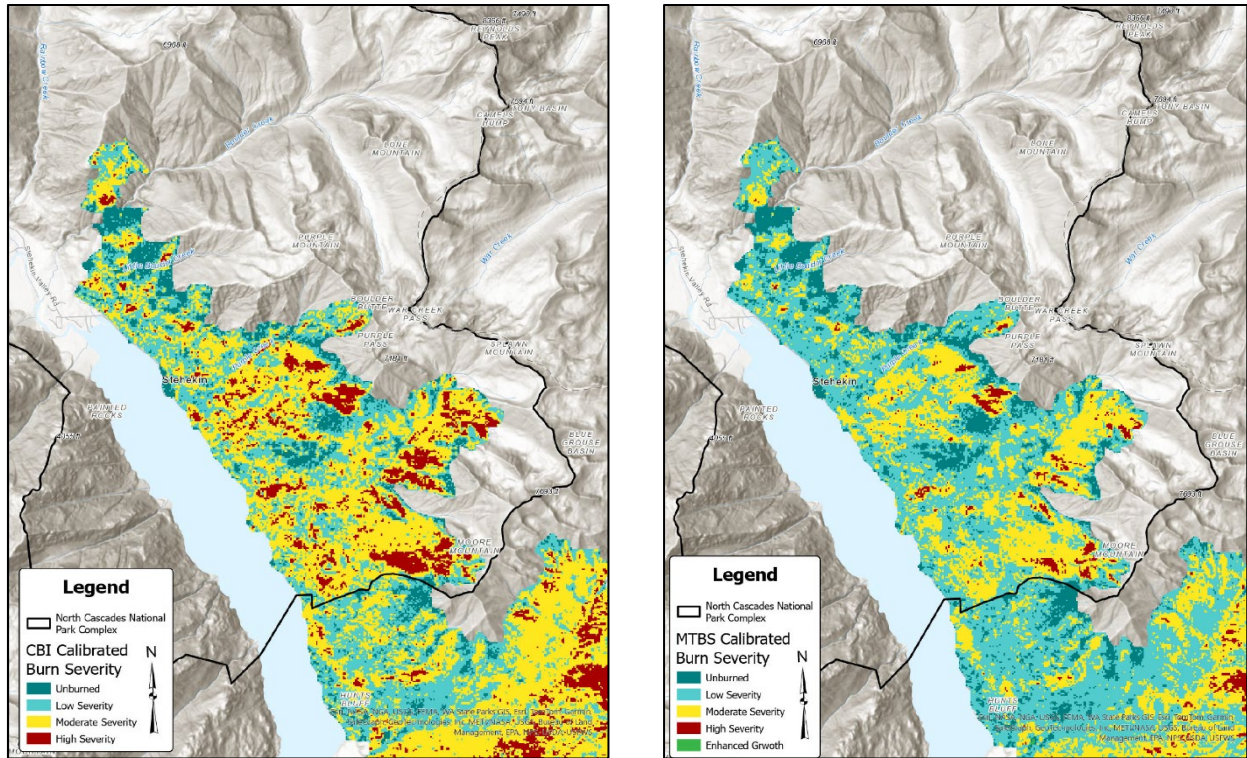


Figure 18. Comparison of map showing NPS land burn severity. Left: CBI calibrated, Right: MTBS calibrated.

Pioneer Comparative CBI Photos:

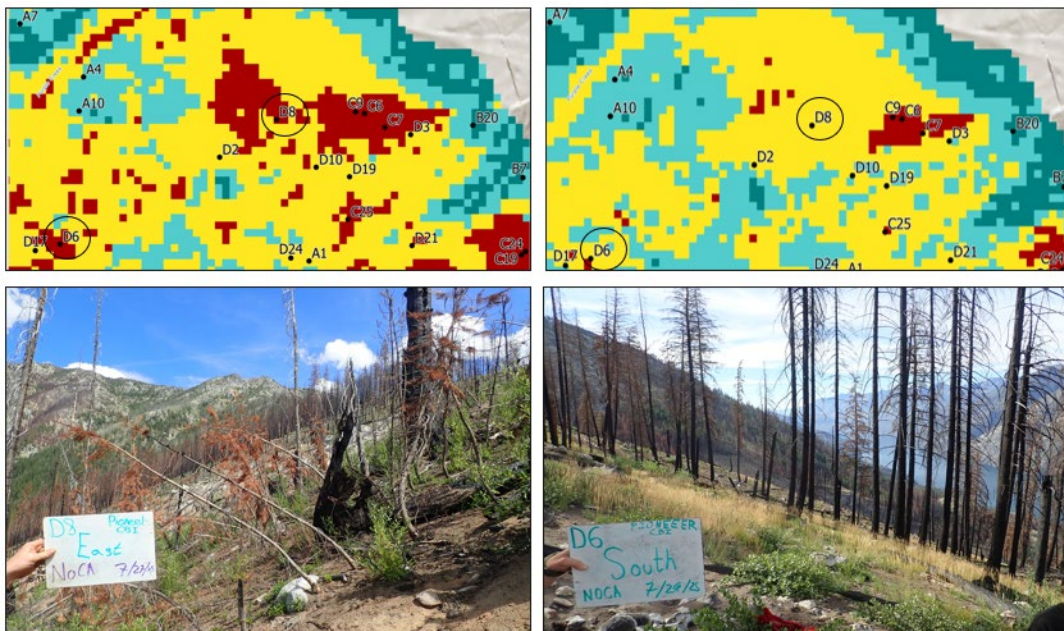


Figure 19. **Top Left:** CBI calibrated burn severity of an area within the Pioneer Fire. **Top Right:** MTBS calibrated burn severity of an area within the Pioneer Fire. **Bottom Left:** Plot D8 photo. **Bottom Right:** Plot D6 photo.

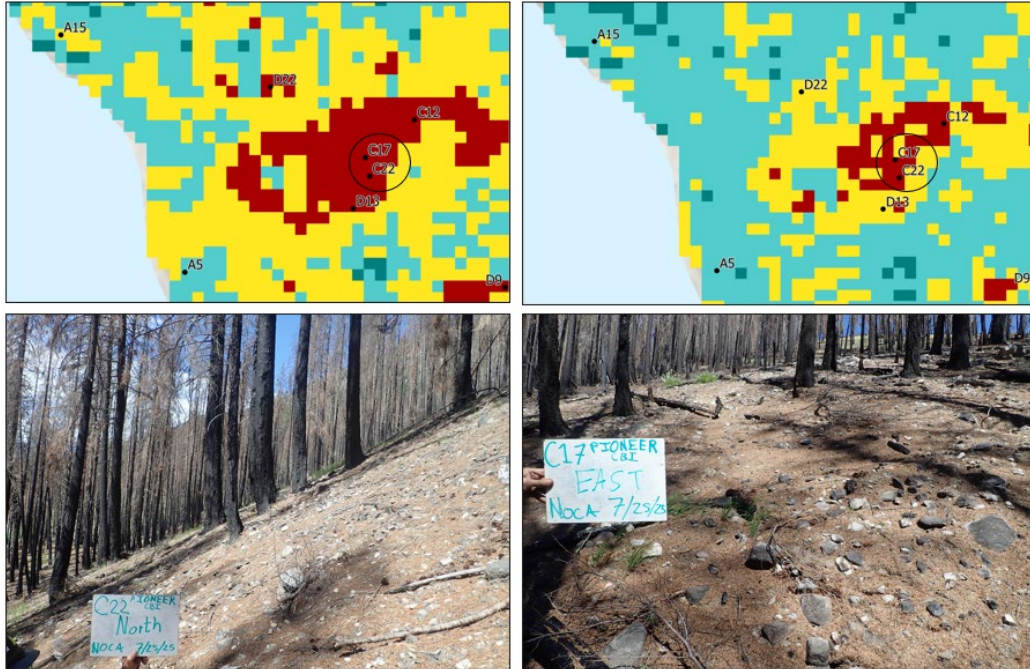


Figure 20. Top Left: CBI calibrated burn severity of an area within the Pioneer Fire. Top Right: MTBS calibrated burn severity of an area within the Pioneer Fire. Bottom Left: Plot C22 photo. Bottom Right: Plot C17 photo.

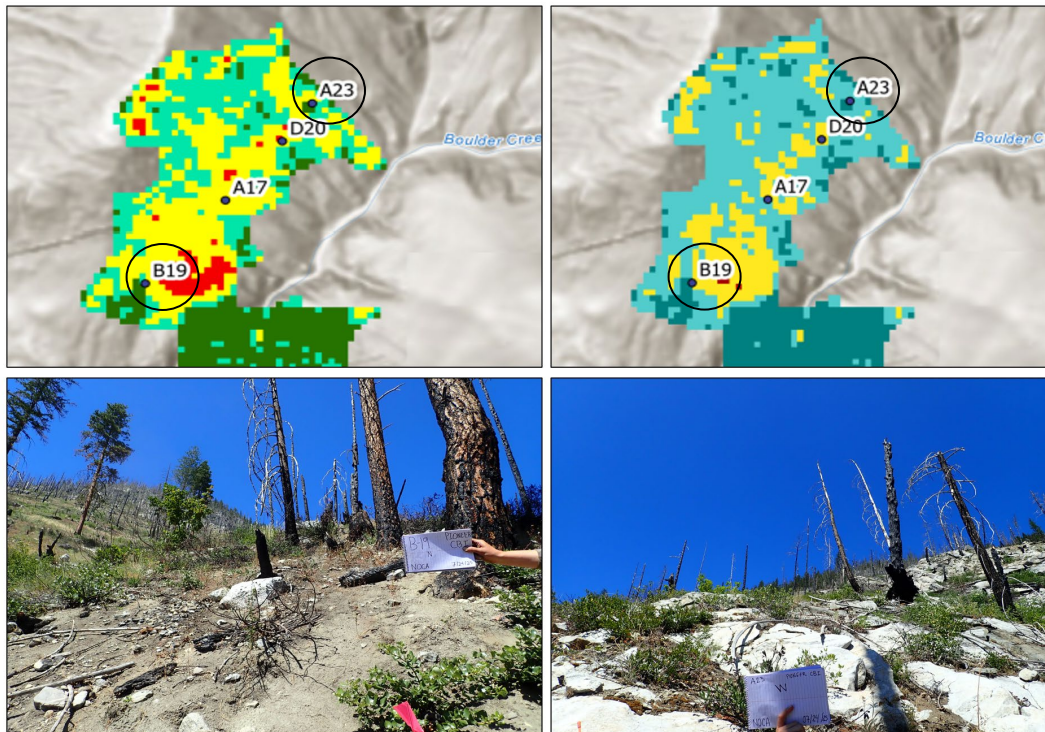


Figure 21. Top Left: CBI calibrated burn severity of an area within the Pioneer Fire. Top Right: MTBS calibrated burn severity of an area within the Pioneer Fire. Bottom Left: Plot B19 photo. Bottom Right: Plot A23 photo.

2024 Ruby Fire

The Ruby Fire was ignited by lightning on August 9th, 2024, in the Ross Lake National Recreation Area within North Cascades National Park Service Complex. The fire burned 1,931 acres of NPS lands dominated by Douglas fir (*Pseudotsuga menzessii*), western hemlock (*Tsuga heterophylla*), and western red cedar (*Thuja plicata*) at lower elevations and Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*) and subalpine fir (*Abies lasiocarpa*) at middle and upper elevations.

In the summer of 2025, the NPCB fire effects crew collected Composite Burn Index (CBI) data within the Ruby Fire burn scar to ground truth and calibrate remotely sensed burn severity imagery provided by the Monitoring Trends in Burn Severity (MTBS) program. CBI was sampled following the same protocols as described for the Pioneer Fire. The crew collected CBI data at 10 locations throughout the burn area in areas of varying burn severity.

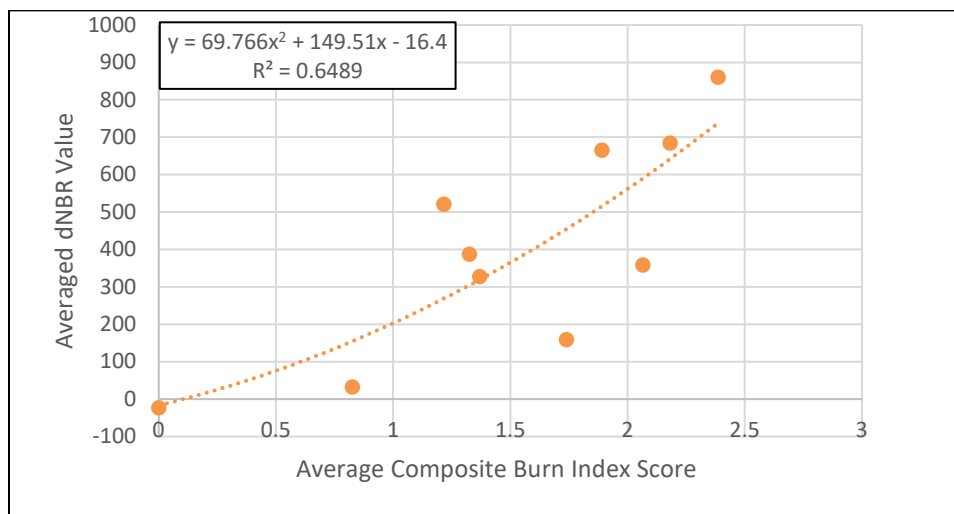


Figure 22. Regression analysis for average CBI score and average dNBR for each CBI plot for the Ruby Fire.

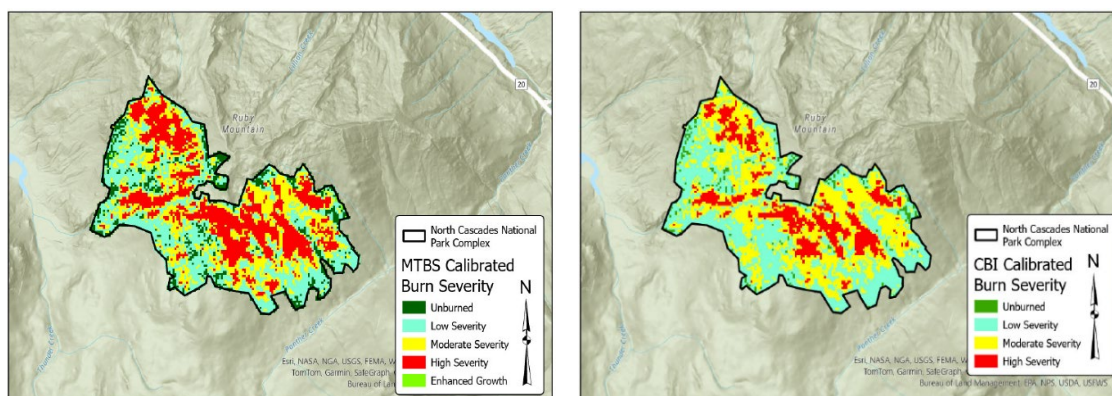


Figure 23. Comparison of CBI calibrated and MTBS calibrated burn severity for the 2024 Ruby Fire. Right: MTBS calibrated. Left: CBI calibrated

Table 9. dNBR thresholds for the Ruby Fire. Left: MTBS determined thresholds. Right: CBI determined thresholds

Burn Severity	MTBS dNBR thresholds		CBI dNBR thresholds	
	Low End	High End	Low End	High End
 Unburned	Min	80	min	-0.8
 Low	81	324	-0.8	279
 Moderate	325	600	279	673
 High	600	Max	673	max

Table 8. Acreage burned by severity class.

Burn Severity	Total Acreage	
	MTBS Classified	CBI Classified
 Unburned	190	34
 Low	564	677
 Moderate	428	648
 High	449	272

Management Recommendations:

Burn severity maps are useful products for resource managers in their ability to communicate predictions of post-fire conditions such as threats to public safety and infrastructure, increased erosion, likelihood of invasives infestation, habitat change, and vegetation change.

The ground truthing of MTBS Burn Severity Maps through CBI fieldwork to recalibrate burn severity category thresholds increases the accuracy and specificity of these products. Comparisons of MTBS derived, Soil Burn Severity (SBS) recalibrated, and CBI recalibrated versions of the same fire area may inform recurrent patterns about how remote-sensed dNBR imagery under or over predicts burn severity classifications in a particular geographic area.

Furthermore, the value of CBI is doubly useful when conducted at the plot origin of FMH plots which have been burned over by wildfires as it provides a detailed, systematic, and consistent assessment of burn severity at the plot scale which can help to interpret the cause of short and long-term fire effects at the location into the future.

Accordingly, it is recommended that the NPCB Fire Ecology Program continue to conduct the CBI recalibration of MTBS Burn Severity Maps for wildfires of significance and that these maps be curated into a common library to inform future comparative analysis.

C. Research, Planning, and Communication

NPCB Monitoring Plans

- [NOCA](#)
- [LARO](#)

NPCB 2025 BAER Plans

- Bear Gulch Fire BAER Plan (OLYM)
 - [version 1](#)
 - [version 2](#)
- [Perry Fire BAER Plan](#) (NOCA)

Post-Fire Response Plans

- [2025 Pioneer Fire Stehekin Landing Post-Fire Debris Flow Standard Operating Procedures](#) (NOCA)

Post-Fire Accomplishment Reporting

- [2025 NOCA Post-Fire Accomplishment Report](#)

NPS Resource Advising

- [NPS Local Unit READ Guide \(LURG\) Template](#)
- [NOCA Local Unit READ Guide](#) (2025 Revision)
- [NPS READ SharePoint](#)
- [PWR READ SharePoint](#)

Major Presentations with NPS Staff

- [NPS National READ Refresher](#)
- LURG Development/Integration: NPS Fire Planners Working Group
- LURG Development/ Integration: NPS Cultural Resource Leads
- LURG Kickoff Workshop (MORA)

Major Presentations with Other Audiences

- Upper Skagit Collaborative NOCA/ Seattle City Light Fuels Management Planning
- NOCA/ Seattle City Light Sourdough Fire Diablo Townsite Protection Planning
- Interagency Lead READ Training

D. Future Direction for NPCB Fire Ecology Program

With the transition of the NPS Wildland Fire Program to the US Wildland Fire Service beginning in January 2026, mid-to long-term program goals are unclear at this time.

Nevertheless, the following projects are in progress or anticipated in 2026:

- NPCB Fire Effects Monitoring Crew
 - FMH Plot Monitoring
 - NOCA
 - LARO
 - SAJH
 - CBI
 - Perry Fire CBI (NOCA)
 - Bear Gulch CBI (OLYM)
 - Wildfire, Prescribed Fire and BAER Team Incident Support
 - DOI BAER Team
- NOCA Fire Management Plan Revision
- NOCA Stehekin Valley Forest Fuels Reduction Area (FFRA) Planning and Review
- Upper Skagit Collaborative NOCA/ Seattle City Light Fuels Management Planning
- NOCA/ Seattle City Light Sourdough Fire Diablo Townsite Protection Planning
- 2025 NOCA Flooding Recovery Support
- Local Unit READ Guide Development
 - NOCA READ Atlas
 - OLYM LURG & READ Atlas
 - MORA LURG & READ Atlas
 - LARO LURG & READ Atlas
- NOCA Post-Fire Implementation & Accomplishment Reporting
 - Chilliwack Complex
 - Sourdough Fire
 - Pioneer Fire
 - Perry Fire
- PWR FAM READ Coordination
- Interagency Lead READ Training
- NPS/USFS Western Washington M-280 READ Training

E. References, Links, and Additional Reading

Literature References

Lutes, Duncan C.; Keane, Robert E.; Caratti, John F.; Key, Carl H.; Benson, Nathan C.; Sutherland, Steve; Gangi, Larry J. 2006. FIREMON: Fire effects monitoring and inventory system. Gen. Tech. Rep. RMRS-GTR-164-CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. LA-1-55

Miller, J.D., and A. E. Thode. 2007. Quantifying burn severity in a heterogeneous landscape with a relative version of the delta Normalized Burn Ratio (dNBR). Remote Sensing of the Environment 109: 66-80

North Cascades National Park Fire Ecology Program. 2017. Recalibrate Burn Severity Maps with CBI data.

US Geological Service and US Forest Service. Monitoring Trends in Burn Severity. November 16, 2024. <http://www.mtbs.gov/index.html>

Links to IRMA Data Store Records for NPCB FFI Databases

- [NOCA](#) (updated 6.25.25)
- [LARO](#) (updated 6.25.25)
- [SAJH](#) (updated 6.25.25)
- [JODA](#) (updated 6.25.25)
- [WHMI](#) (updated 10.23.14)

[Link to 2025 NPCB Fire Ecology Program Success Story](#)

Appendix A. Staffing and Accomplishments

Table A-1. Fire Ecology Staffing 2025

Ecologist and Monitors	Position	Appointment Length	Training and Development
Cedar Drake	Fire Ecologist	PFT – 26 pay periods 1/13/25 – 9/30/25	NPS Supervisory Foundations and NPS administrative trainings, NPS LIDAR training, WFDSS Next Gen training, Remote Incident Support Team (RIST) training, IFPRS Post-Fire training, DOI National BAER Team training, RT-130
Kate Patronik	Lead Monitor	Term – 26 pay periods 10/1/24 – 9/30/25	S-230, RT-130, graduate school (7 credits), CRWB PTB initiated
Isaac Comcowich	Monitor	Temp – 12 pay periods 4/28/25 – 9/30/25	RT-130, REAF qualification completed
Bella Myrah	Monitor	Temp – 12 pay periods 4/20/25 – 9/30/25	RT-130, FFT1 PTB initiated
Cade Simpson	Monitor	Temp – 12 pay periods 4/20/25 – 9/30/25	RT-130, S-290

Table A-2. Fire Ecologist 2025 Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	24%	NPS/Seattle City Light Collaborative Fuel Treatment Planning, NPS/Seattle City Light Sourdough Fire Diablo Town Site Protection Planning, Pioneer Fire Stehekin Landing Post-Fire Debris Flow Standard Operating Procedures, Stehekin Forest Fuels Reduction Area Planning
BAER Implementation	20%	NOCA BAER treatment implementation and accomplishment reporting for Bear Creek Fire, Chilliwack Complex, Sourdough Fire, Pioneer Fire. USGS/NPS IAA management, Minimum Requirement Analysis (MRA) development, PEPC/IDT participation
READ Coordination	15%	NPS, PWR, and NOCA READ coordination, NPS READ Refresher, 2025 revision of NOCA Local Unit READ Guide (LURG), development of NOCA READ Atlas, assisted LURG development at OLYM, MORA, PORE, and GOGA via support to PWR LURG Fellow, instructed Lead READ training, supported JOTR N-9042 READ course, developed NPS READ SharePoint, developed 2025 NPS READ qualifications crosswalk, advised on NWCG READ qualification standards, served as NPS primary member on NWCG READ Subcommittee, advised British Columbia Fire program on development of READ qualifications and standards.
Supervision/ admin tasks	15%	Hiring, supervision, payroll, travel, purchasing, budget, fleet, technical support, logistics, performance, HR issues, etc.
Wildfire assignments	13%	Lead READ (REAC) assignments: Bear Gulch (OLYM) & Perry (NOCA). Deputy BAER Team Leader/ Document Specialist assignments Bear Gulch (OLYM) & Perry (NOCA)
Field work/ data collection	4%	FMH data collection with NPCB Fire Effects Crew at NOCA & LARO
Training	3%	NPS Supervisory Foundations and NPS administrative trainings, NPS LIDAR training, WFDSS Next Gen training, Remote Incident Support Team (RIST) training, IFPRS Post-Fire training, DOI National BAER Team training, RT-130
Data management	2%	FFI QA/QC
Data analysis	2%	FMH data analysis and data summaries
Presentations	1%	LURG development/integration: NPS Fire Planners Working Group & NPS Cultural Resource Leads
Meetings/ task groups	1 %	PWR FAM DO & FMO calls

Table A-3. Fire Effects Crew 2025 Accomplishments/Focus Areas

Category	Percent Time	Notes
Data collection	41%	FMH plots, CBI plots
Wildfire assignments	18%	FFT1, HECM, FFT2, REAF, FEMO assignments
Prescribed fire/fuels treatment projects	9%	FEMO, FFT1, FFT2 on Napoleon RX at LARO. Fuel reduction projects at LARO. Pile burning at LARO, RXB3
Travel out-of-park for plot or project work	7%	Large majority of plot work requires half-day to a full day of travel to access units.
Data entry/management	6%	Managing data in FFI, preparing or archiving data, transferring data from tablet to computer
Data analysis	5%	Time spent assisting Fire Ecologist in data analysis tasks
Administrative activities	2%	Payroll, travel authorization/voucher, etc., crew lead tasks
Training	7%	First Aid/CPR S-230 S-290 RT-130
Miscellaneous	5%	Time assisting Whitebark pine vegetation crew

Appendix B. History of Fire Effects Monitoring Plots

Table B-1. All Fire Effects Plots Established

Park	Monitoring Unit	Plot Type	Pre-burn 2025	Imm. Post 2025	Postburn (1-20 yrs) 2025	Annual Total (2025)	Total Plots
North Cascades NP	Stehekin Valley FFRA: Mixed Conifer	FMH Forest	0	0	13	13	54
	Stehekin Valley Contours (Open/Mid/Closed Canopy Mixed Conifer)	FMH Forest	0	0	4	4	23
	2024 Pioneer Fire	CBI*	0	0	41	41	41
	2024 Ruby Fire	CBI*	0	0	10	10	10
	Douglas Fir/ Western Hemlock/ Western Red Cedar	Westside Fuels Reduction	0	0	4	4	26
	2017 ELC Diablo	RAP	0	0	0	0	6
Lake Roosevelt NRA	Ponderosa Pine/ Common Snowberry Forest	FMH Forest	0	0	15	15	60
	Ponderosa Pine/Bitterbrush	FMH Forest	0	0	0	0	3
San Juan Island NHP	Garry Oak Woodland	FMH Forest	0	0	0	0	12
	Non-Native Brome	Experimental	0	0	0	0	10
	Douglas Fir/ Lodgepole (permanent RAPS plots)	Rapid Assessment	0	0	0	0	4
	Annual Brome Grasses	FMH Grass	0	0	0	0	6
	Coastal Prairie Grassland	FMH Grass	0	0	0	0	6
John Day Fossil Beds NM	Big Sagebrush/Bunchgrass	FMH Brush	0	0	0	0	18
	Western Juniper Shrubland	FMH Forest	0	0	0	0	16
Olympic NP	East-side Mixed Conifer (permanent RAPS plots)	Rapid Assessment	0	0	0	0	5
Whitman Mission	Giant Wild Rye Meadow Restoration	FMH Grass	0	0	0	0	5
Total			0	0	87	87	305

*Only CBI plots from the 2025 field season have been included in this table.