



National Park Service North Pacific/Columbia Basin Fire Ecology Fire Ecology Annual Report Calendar Year 2023

**Kate Patronik, Lead Fire Effects Monitor
Karen Kopper, Fire Ecologist**



2022 Chilliwack Complex, 1-year post-fire. 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.

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A. Summary

The North Pacific/Columbia Basin (NPBC) Fire Ecology program experienced a dynamic 2023 field season. The fire effects monitoring crew completed 55 plots within North Cascades National Park (NOCA), Lake Roosevelt National Recreation Area (LARO), and San Juan Island National Historic Park (SAJH). The crew was also involved in wildfire assignments and prescribed fire trainings throughout the season.

Early Season: The lead monitor, Kate Patronik, returned to NOCA this season in mid-April. After onboarding, she participated in two prescribed burns within the park units. The assistant crew lead, Isaac Comcowich, started in early May. Kate and Isaac headed out to SAJH and were able to collect this year's data and attend the virtual resource advisor training. At the end of May, Kate attended the NPS Women in Wildland Fire workshop in New York, while Isaac prepped gear for the incoming crewmembers. Two SCA interns, Bella Myrah and Stella Cook, joined the crew in mid-June. After all onboarding tasks were completed, the crew traveled to LARO to train on FMH protocols and complete two plots.

Mid-Season: In the swing of field season, the crew worked 8-day hitches alternating between LARO and NOCA FMH plots. At the end of July, the crew hiked into the NOCA backcountry to collect Composite Burn Index (CBI) data in the 2022 Chilliwack Complex. The workload was split into 2, 8-day hitches. The first was at low elevation to monitor old growth response, and the second at high elevation. The second backcountry trip consisted of the fire effects crew, the NOCA archeology crew, and a whitebark pine crew. Crewmembers cross-trained and created new relationships within NOCA staff, which was highly enjoyable. Much of the data collected on this trip will be used by the Chilliwack BAER team. While the crew was on the first backcountry trip, the Sourdough fire started within NOCA. The fire ecologist, Karen Kopper, was the Lead READ for the first two weeks of the Sourdough fire. Some members of the crew worked as REAF trainees on the fire, but the main priority was to finish the work in the Chilliwack.

In late August, the majority of the 2023 workload was completed, and the crew transitioned into wildfire assignments. The Sourdough fire had a lot of resources, and upper fire management staff approved the crew to go off unit. Kate, Isaac, and Stella went down to Oregon to join the USFS Fire Behavior Assessment Team (FBAT) on the Lookout fire. After a quick R&R, they returned to Oregon to finish assessments on the installed plots. This relationship was highly valuable for all crewmembers, and we hope to continue to support FBAT in the future.

Late Season: After some time on wildfire assignments, the crew reset to finish the last of the FMH plots in NOCA, and Karen joined the Sourdough BAER team to work on the old-growth and Whitebark pine assessments. With all the data collected for the season, Isaac worked with the vegetation crew to monitor whitebark pine seed trees, and the rest of the crew helped backhaul gear on the Sourdough fire. The crew also collected immediate post data on the FMH plots within the Sourdough fire. At the start of October, Kate and Bella, attended the Selkirk prescribed fire training exchange (TRES). Kate attended the TRES as the FEMO trainer, and Bella attended as a FEMO trainee. Isaac also attended the Columbia TRES as a FEMO trainee. The whole crew spent the last week of the season entering and checking data, cleaning gear, and prepping for next season.

Table 1. Fire Effects Plot Workload (2023)

Park	Monitoring Unit	Plot Type	Years Data Collected (start-end)	Annual Total (2023)	Total Plots
North Cascades NP	Stehekin Valley FFRA: Mixed Conifer	FMH Forest plot	1996-2023	13	52
	Westside Plots	FMH Forest plot	2021-2023	2	26
	2022 Chilliwack Complex	CBI	2023	24	24
Lake Roosevelt NRA	Ponderosa Pine/ Common Snowberry Forest	FMH Forest plot	2001-2023	14	63
San Juan Island NHP	Douglas Fir/ Lodgepole (permanent RAP plots)	Rapid Assessment	2009-2023	2	4
Total				55	169

B. Monitoring Results and Recommendations

2023 NOCA Management Objectives and Monitoring Results

Table 2. 2023 NOCA Management Objectives and Monitoring Results

Management Objective	Monitoring Results n = number of plots PRE = pre-burn average (standard deviation) YR01 = 1 year post thinning YR02 = 2 years post pile burn with 1 thinning YR05 = 5 years post pile burn with 1 thinning	Objectives Met?
Trees		
Reduce the density of live pole size trees (1 – 6" dbh) to 10-30 trees/acre as measured 2 years after final treatment prior to maintenance.	Upper McGregor Unit: n=5 PRE = 51.0 (16.8) trees/acre YR01 = 39.7 (17.0) trees/acre YR02 = 32.4 (16.9) trees/acre YR05 = 28.3 (13.7) trees/acre	Objective achieved
Reduce the density of live small and medium sized overstory trees (6-24" dbh) to 25-75 trees/acre as measured 2 years after final treatment prior to maintenance.	Upper McGregor Unit: n=5 PRE = 106 (9.3) trees/acre YR01 = 79.3 (11.3) trees/acre YR02 = 77.7 (8.8) trees/acre YR05 = 72.8 (8.1) trees/acre	Objective achieved
Maintain the density of large overstory trees (>24" dbh) at 1-20 trees/acre as measured 2 years after final treatment prior to maintenance.	Upper McGregor Unit: n=5 PRE = 12.1 (5.0) trees/acre YR01 = 12.9 (5.3) trees/acre YR02 = 12.9 (5.3) trees/acre YR05 = 11.3 (7.2) trees/acre	Objective achieved
Reduce live basal area to an average of 70 ($\pm$ 35) ft ² / acre as measured 2 years after final treatment prior to maintenance.	Upper McGregor Unit: n=5 PRE = 183.7(19.3) ft ² /acre YR01 = 159.3 (17.7) ft ² /acre YR02 = 162.3 (18.8) ft ² /acre YR05 = 145.2 (15.6) ft ² /acre	Not achieved

Increase seedlings (<1 m. tall) and saplings (1-3 m. tall) to 25 – 75 PIPO live seedlings per acre by 2 years post-treatment.	Upper McGregor Unit: n=5 PRE = 0 saplings/acre, 0 seedlings/acre YR01 = not collected YR02 = 12.9 (28.9) saplings/acre, 77.7 (94.6) seedlings/acre YR05 = 6.5 (14.5) saplings/acre, 16.18 (36.2) seedlings/acre	Objective achieved
Increase live canopy base height to 2 meters as measured 1-year post-treatment.	Upper McGregor Unit: n=5 PRE = 11 (1.1) meters YR01 = 11 (1.6) meters YR02 = 11.4 (1.4) meters YR05 = 11.7 (1.2) meters	Objective achieved
Vegetation		
Maintain a minimum of 30 percent cover of live native understory vegetation 2 years after the initial treatment.	Upper McGregor Unit: n=5 PRE = 40 (19.8) % YR01 = not collected YR02 = 56.1 (18.9) % YR05 = 48.12 (10.9) %	Objective achieved
Report percent cover of non-natives per species. Alert managers to the presence of new exotic species, and work with them to determine critical thresholds.	Upper McGregor Unit: n=5 No non-native species found	Objective achieved
Fuel Loading		
Maintain an average small diameter (1-100 hour) fuel load of 2-6 tons/acre 2 years after final treatment prior to maintenance.	Upper McGregor Unit: n=5 PRE = 4.0 (2.3) tons/acre YR01 = 5.8 (2.0) tons/acre YR02 = 5.8 (2.9) tons/acre YR05 = 5.4 (1.9) tons/acre	Objective achieved
Maintain an average large diameter (1000 hour) fuel load of 4-12 tons/acre 2 years after final treatment prior to maintenance.	Upper McGregor Unit: n=5 PRE = 18.6 (14.9) tons/acre YR01 = 17.4 (11.2) tons/acre YR02 = 15.9 (12.0) tons/acre YR05 = 19.0 (15.0) tons/acre	Not achieved
Maintain an average litter and duff load of 3.5-14 tons/acre 2 years after final treatment prior to maintenance.	Upper McGregor Unit: n=5 PRE = 22.3 (4.9) tons/acre YR01 = 21.6 (3.7) tons/acre YR02 = 25.1 (3.9) tons/acre YR05 = 29.0 (4.7) tons/acre	Not achieved

NOCA: Stand conditions and recommendations in the Upper McGregor Unit

The main goals of the Stehekin forest fuel reduction areas (FFRAs) are to reduce hazard fuels and restore fire dependent species throughout the populated valley. The Upper McGregor monitoring plots were installed between 2012 and 2016. In 2017, the unit was thinned, and hand piled. Pile burns took place in the fall of 2018 and 2019. These data collected by the NPCB fire effects monitoring crew will be used to help refine the management objectives and guide future treatments.

Trees: Tree density objectives for all size classes have been achieved 5 years post treatment. However, the density of live pole and medium overstory trees are on the high end of the

parameters. The two dominant trees species in the unit are Douglas fir (*Pseudotsuga menziesii*) (PSME) and ponderosa pine (*Pinus ponderosa*) (PIPO), with PSME densities greatly outnumbering PIPO in all size classes. The large overstory trees have slightly decreased from 12.1 trees/acre pre-treatment to 11.3 trees/acre 5 years post. Our data shows mistletoe damage was common within the large overstory trees, which may have factored in this slight decrease. We do not believe the unit treatments were an integral part in the observed large tree mortality.

The average basal area has been decreasing year-to-year yet has always been above the prescription's parameters. 5 years post, the average basal area was 145.2 ft²/ac, and the target range is 70 (± 35) ft²/ac. With both pole and medium overstory trees on the high end of the desired conditions, it is not surprising that the basal area is out of prescription.

Seedlings and saplings in the Stehekin Valley are focused on the recruitment of PIPO. Pre-treatment, there were no PIPO in the unit, 5 years-post the PIPO seedlings and saplings have increased to 16.2 and 6.5 stems/acre respectively. PSME seedlings and saplings are more common throughout the Stehekin valley as exemplified in our data. PSME saplings and seedlings 5 years post were measured at 19.4 saplings/acre and 1821.9 seedlings/acre.

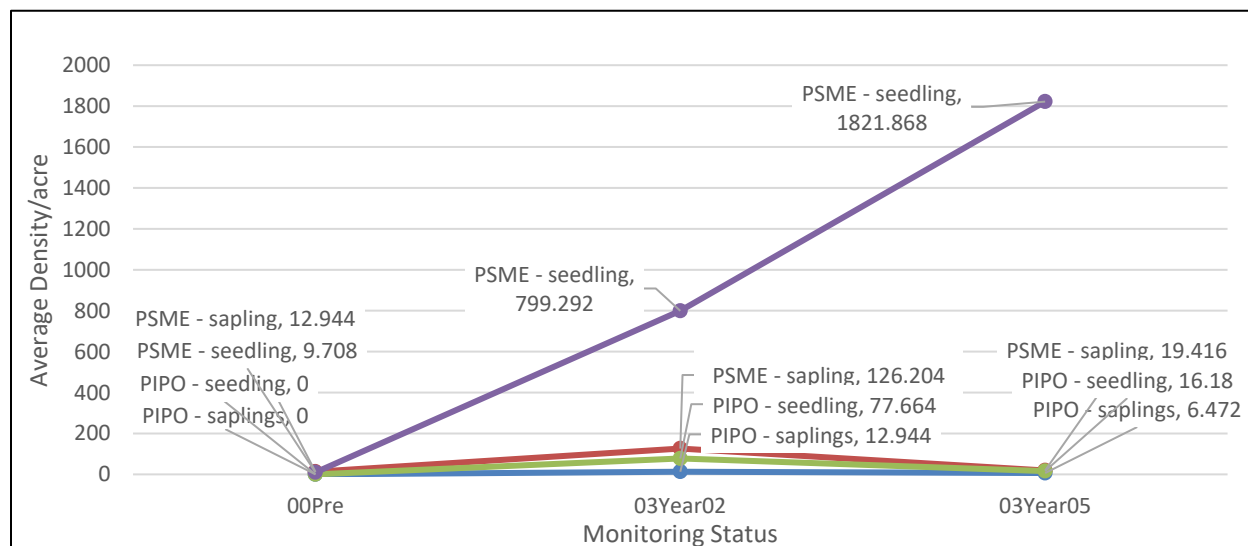


Figure 1. Seedling and sapling density in the Upper McGregor unit

Our data shows that both PSME and PIPO sapling densities decreased from year 2 to year 5, as did the PIPO seedlings. This change in density could be due to some trees moving into the overstory tree size class, or natural thinning out due to competition for light.

Vegetation: 5 years post-burn, the unit averages 48% cover of live native species in the understory which is an increase from the 40% cover observed pre-treatment. Perennial grasses cover 25% of the unit, with Alaskan onion grass (*Melica subulata* var. *subulata*) and pinegrass (*Calamagrostis rubescens*) being most common. Largeleaf sandwort (*Moehringia macrophylla*) was the most dominant forb throughout the unit with 7% cover. White spiraea (*Spiraea betulifolia*) and holly-leaved barberry (*Berberis aquifolium*) were the most abundant shrub species, yet overall shrub cover was low at 6.4%. No non-native species were found within the unit.

Fuels: The 1000-hour fuels and litter/duff loads within the Upper McGregor unit are over stocked. The litter and duff in the unit measured 29.0 tons/acre, which is 15 tons greater than the high-end parameter. 1000-hr fuels were measured at 19.0 tons/acre, and the desired conditions are no greater than 12 tons/acre. The heavy fuels in this unit are equally varied between rotten and sound logs. Given time, the heavies will transition into the rotten category. The fine woody fuels are at 5.4 tons/acre, which is within the desired parameters, but reaching the high limit of 6 tons/acre. These numbers are expected with a pile burn treatment, given the small area that is burned. Litter and duff objectives will be hard to meet, if the unit continues to be pile-burned.

Recommendations: Our recommendations for the Upper McGregor unit consist of two treatments. The first, a gap and patch thin targeting pole-sized and small diameter overstory trees to create more heterogeneity within the stand and reach the desired basal area measurements. This will help prep the unit for the second treatment of a broadcast burn within the next 3 to 5 years following the thinning. A broadcast burn will benefit the unit by consuming fuels of all size classes. We recommended targeting the 1000-hr fuels and the litter and duff. With the decrease of litter and duff in combination with canopy openings, the PIPO seeds will have a greater possibility to establish within the unit. With these treatments, we also recommend people working in the unit be mindful not to track in non-native species, simply by checking and cleaning footwear and equipment.

Photopoints:

North Cascades National Park: Stehekin Valley Forest Fuels Reduction Area: Mixed Conifer



FPSME2-58 00PRE



FPSME2-58 03Year05



FPSME2-49 00PRE



FPSME2-49 03Year05

2023 LARO Management Objectives and Monitoring Results

Table 3. 2023 LARO Management Objectives and Monitoring Results

Management Objectives	Monitoring Results n = number of plots (standard deviation) YR01 = 1 year post thin YR02 = 2 years post thin + broadcast burn YR05 = 5 years post thin + broadcast burn	Progress Towards Meeting Objectives
Trees		
Reduce the density of live pole size trees (1 – 6" dbh) to 2-20 trees/acre as measured 2 years after final treatment prior to maintenance.	Ricky Point Unit: n=3 PRE = 91.7 (51.2) trees/acre YR01 = 12.1 (12.1) trees/acre YR02 = 1.4 (2.3) trees/acre YR05 = 1.4 (2.3) trees/acre	Not achieved
Reduce the density of live small and medium sized overstory trees (6-24" dbh) to 25-75 trees/acre as measured 2 years after final treatment prior to maintenance.	Ricky Point Unit: n=3 PRE = 130.0 (60.1) trees/acre YR01 = 103.9 (52.8) trees/acre YR02 = 85.0 (70.2) trees/acre YR05 = 43.2 (52.2) trees/acre	Objective achieved
Maintain or increase the density of live large overstory trees (>24" dbh) at 1-8 trees/acre as measured 5 years after final treatment prior to maintenance.	Ricky Point Unit: n=3 PRE = 1.35 (2.4) trees/acre YR01 = 1.35 (2.4) trees/acre YR02 = 1.35 (2.4) trees/acre YR05 = 1.35 (2.4) trees/acre	Objective achieved
Reduce live mean basal area to an average of 70 ($\pm$ 35) ft ² / acre as measured 2 years after final treatment prior to maintenance.	Ricky Point Unit: n=3 PRE = 111.6 (52.8) ft ² /ac YR01 = 101.1 (53.6) ft ² /ac YR02 = 91.35 (74.1) ft ² /ac YR05 = 44.8 (50.2) ft ² /ac	Objective achieved
Reduce the density of seedlings (<1 m. tall) and saplings (1-3 m. tall) to 2 – 20 live seedlings per acre as measured 2 years after final treatment prior to maintenance.	Ricky Point Unit: n=3 PRE = 1418.4 (1506.8) saplings/ac, 1488.6 (1351.3) seedlings/ac YR01 = 1456.2 (1375.9) saplings/ac, 280.5 (230.2) seedlings/ac YR02 = 474.6 (808.1) saplings/ac, 2572.6 (872.5) seedlings/ac YR05 = 555.5 (491.4) saplings/ac, 868.3 (866.1) seedlings/ac	Not achieved
Increase live canopy base height (poles+overstory) to 2 meters as measured 1-year post-treatment.	Ricky Point Unit: n=3 PRE = not collected YR01 = not collected YR02 = 12.8 (4.9) meters YR05 = 10.0 (8.64) meters	Objective achieved
Vegetation		
Maintain a minimum of 30 percent cover of live native understory vegetation 2 years after the initial treatment.	Ricky Point Unit: n=3 PRE = 18.0 (8.6) % YR01 = not collected YR02 = 33.0 (22.3) % YR05 = 36.2 (9.9) %	Objective achieved

Maintain <20% relative cover of non-native understory vegetation (shrubs and graminoids and herbaceous) by 5 years following treatment.	Ricky Point Unit: n=3 PRE = 16.7 % YR01 = 36.6 % YR02 = not collected YR05 = 32.3 %	Not achieved
Fuel Loading		
Maintain an average small diameter (1- 3") woody fuel load of 2–6 tons/acre 2 years after final treatment prior to maintenance.	Ricky Point Unit: n=3 PRE = 3.5 (2.16) tons/ac YR01 = 3.8 (1.3) tons/ac YR02 = 2.8 (0.5) tons/ac YR05 = 3.9 (2.5) tons/ac	Objective achieved
Maintain an average large diameter (1000 hour) fuel load of 4-12 tons/acre 2 years after final treatment prior to maintenance.	Ricky Point Unit: n=3 PRE = 4.9 (2.3) tons/ac YR01 = 8.0 (3.3) tons/ac YR02 = 6.4 (4.0) tons/ac YR05 = 5.6 (4.3) tons/ac	Objective achieved
Maintain an average litter and duff fuel load of 3.5-14 tons/acre 2 years after final treatment prior to maintenance.	Ricky Point Unit: n=3 PRE = 21.0 (0.6) tons/ac YR01 = 12.2 (0.9) tons/ac YR02 = 11.3 (0.5) tons/ac YR05 = 17.1 (2.6) tons/ac	Not achieved

LARO: Stand conditions and recommendations in the Ricky Point Unit

Lake Roosevelt National Recreation Area management goals are to improve stand structure characteristics, reduce probability of pine bark beetle infestation, reduce hazard fuels, and minimize cover of invasive species. The Ricky Point monitoring plots were installed and thinned in 2006. In the spring of 2018, the unit was broadcast burned, since then, the fire effects monitoring crew has re-visited the unit 2-years and 5-years post-burn, below are our results and recommendations.

Trees: Tree densities in the Ricky Point unit are within desired conditions for the medium and large overstory trees. However, the medium overstory trees have decreased by almost half in the past 3 years. 2-years post, there was an average of 85.0 trees/acre and 5 years post there is an average of 43.2 trees/acre. The pole sized trees have a lower density than desired at 1.4 trees/acre. The basal area has also decreased by half in the last 3 years from 91.35 ft²/acre to 44.8 ft²/acre, which is on the low end of the desired conditions. The density of standing dead in the unit has greatly increased, (PRE= 21.6 trees/acre to Year 5 = 91.7 trees/acre) and now outnumber the living trees in the unit (Figure 2).

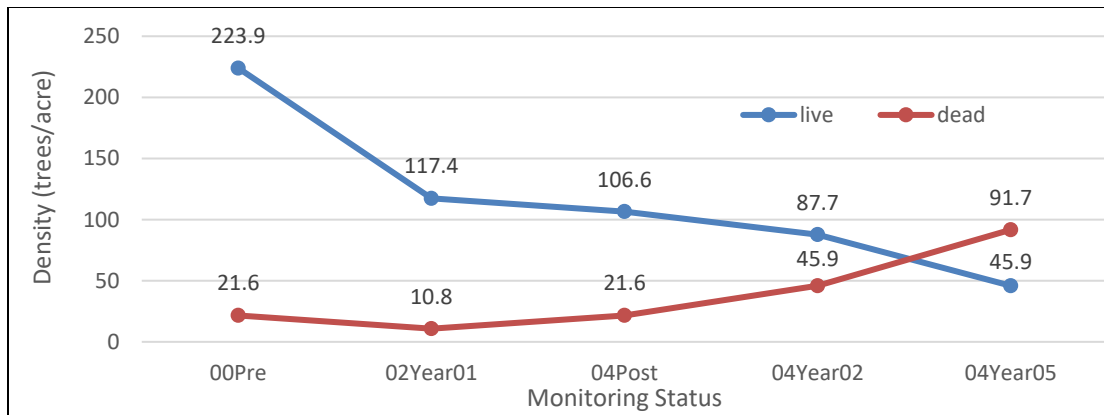


Figure 2. Density of live and dead trees in the Ricky Point unit

We interpret this extreme change from year 2 to year 5 to have occurred due to a few different factors. First, the unit burned very hot, resulting in high latent mortality of trees. Second, the crowded stand conditions and stress from the high fire behavior weakened the resistance of the remaining trees, triggering an Ips beetle attack.

While the overstory trees are being severely impacted by beetle kill, the seedlings and saplings are still above desired parameters. With the amount of dead overstory, there will be a need for PIPO recruitment, and these densities will help bring the stand back to desired conditions.

Vegetation: The native understory vegetation in the Ricky Point unit has increased by 18% since pre-treatment. The native species include silky lupine (*Lupinus sericeus*) at 29% cover, Ross's sedge (*Carex rossii*) at 15.4%, and arrowhead balsamroot (*Balsamorhiza sagittata*) at 10.5%. Native shrubs cover 9.9% and native grasses cover 31% of the unit. The increase in understory is expected given the opening of the canopy.

The two most common non-natives in the unit, 5 years post, are cheatgrass (*Bromus tectorum*) and sheep sorrel (*Rumex acetosella*) with 24.7% and 18.4% cover, respectively. The relative cover of non-natives was observed at 32.3% in the fifth-year post-burn, whereas the desired condition is to maintain less than 20% relative cover of non-natives. It is likely that the increase in non-natives resulted from the high intensity broadcast burn, which allowed for the non-native seeds to quickly establish in the bare soil.

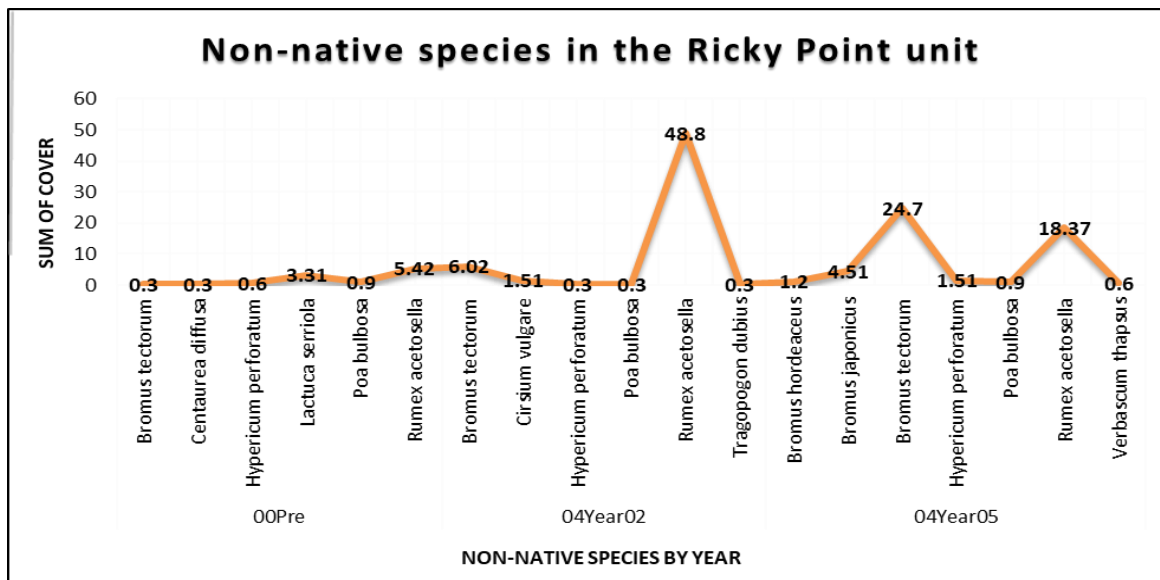


Figure 3. % cover of non-native species in the Ricky Point Unit

Fuels: The woody fuels in the Ricky Point unit are within the desired parameters, but the litter and duff loading are higher than desired at 17.1 tons/acre. This increase in the litter could be due to the increase in dead trees dropping needle cast. With the amount of dead standing trees in the unit, we expect the downed woody fuels to increase over the next few years.

Recommendations: The Ricky Point unit has been marked for thinning of live fire-weakened trees to prevent further spread of the Ips beetle infestation. We highly encourage the park to undertake this thinning as soon as possible. We also encourage the park to continue to work with the forest pathologist to protect the remaining stand from other bark beetles as needed.

Photopoints

Lake Roosevelt National Recreation Area: Ponderosa Pine/ Common Snowberry Forest



FFIPO1-11 00PRE



FFIPO1-11 04Year05



FPIPO1-10 00PRE



FPIPO1-10 04Year05

C. Research, Planning, and Communication

Whitebark Pine Restoration

The NPCB fire ecology program is working on whitebark pine restoration projects funded through the 2022 Chilliwack Complex, 2023 Sourdough Fire, and 2014 Lone Mountain Burned Area Emergency Response Plans. In 2023 the fire effects crew assisted members of the NOCA vegetation crew to survey the Chilliwack burned area and identify high mortality areas in need of restoration. Members of the crew also visited and assessed the condition of potential seed trees for future cone collection. The crew will conduct surveys in the Sourdough and Lone Mountain fire areas again in 2024.

The Fire Ecologist also worked with Eve Bernhard, a master's student at Western Washington University who received PWR reserve funds to complete an internship focused on whitebark pine restoration. Karen Kopper and Eve Bernhard worked with a Compliance specialist to perform a Minimum Requirements Analysis for whitebark pine cone collection and reseedling in the burned area. They developed a plan for the BAER project work and are currently awaiting a Biological Opinion for Fish and Wildlife Service. In addition to this work, Eve Bernhard wrote a summary of recommended procedures for the BAER restoration work.

Climate Adaptation Science Center (CASC) Wildfire RAD Study

The Fire Ecologist has been the primary collaborator at NOCA to work on the CASC 4-Park Resist-Accept-Direct (RAD) Study. At NOCA this project is particularly focused on examining how manager's respond (using the RAD framework (Schuurman et al., 2020)) to managing wildfires in this era of changing fire regimes. In March of 2023, the CASC researchers visited NOCA to conduct interviews with NOCA staff. The researchers are returning to NOCA in

February of 2024 to report back on the interviews and facilitate round-table discussions focused on various climate change scenarios.

CASC PNW Vegetation Transitions Study

Fire ecology and resource management staff at NOCA and MORA are working with Kimberly Davis and others in the USFS Fire Lab to review and provide input on another CASC-funded project. Davis's team is utilizing a carefully developed method based on climate analogs to identify the potential range of variability in current and future biophysical conditions; comparisons between these ranges will highlight areas most vulnerable to vegetation transitions. The main product will be based on a suite of spatial datasets conveying the range of current and future variability for vegetation, fire regimes, and resistance to annual grass invasion for the NW and NC CASC regions. We are excited to continue to participate in this project through its completion.

West-side Fire Regimes

NOCA and Seattle City Light, the hydro-electric company that manages Ross Lake dam embedded in NOCA, recognize the uniqueness of high-severity, low-frequency fire regimes in moist, low-elevation ecosystems on the west-side of the North Cascades and Olympic Mountains. Therefore, they are working jointly on two research projects to inform their revised fire management plan; 1) comparing potential fire behavior in forest stands within the Wildland Urban Interface along Ross Lake (Newhalem, Diablo, Environmental Learning Center and Hozomeen) using different silvicultural prescriptions modeled with Forest Visualization System and fire effects monitoring plot data, 2) modeling the potential size and fire effects of ten previously suppressed fires with the goal of identifying candidate fires for re-ignition in the revised fire management plan. Karen Kopper is finishing up her work with researchers at the USFS Pacific Wildland Fire Science Lab and expects this research to be presented in the Spring of 2024.

PNW Fire Regimes and Climate Change Research

The fire ecologist, Karen Kopper, presented several talks on her dissertation research, "Fire regimes in national parks of the Pacific Northwest: Implications for climate change" (Kopper 2022). The following is a synopsis of this work.

There has been a significant increase in fire activity in the western United States over the past two decades, attributed to climate change, but much of the data that support this attribution are from fires in frequent, low-severity fire regimes. Recent increases in fires with mixed- and high-severity fire regimes of the Pacific Northwest have highlighted the importance of collecting baseline data and understanding fire-climate interactions in forests with less frequent fire to inform research and guide management. My dissertation focuses on these objectives in three chapters:

Chapter 1) Characterized historical fire frequency and severity in a dry, mixed conifer forest (Stehekin, Lake Chelan National Recreation Area in North Cascades National Park Service

Complex) and used ANOVA and GLM to identify the bottom-up controls on fire in this mountainous terrain. It was found that fire was historically frequent (31-year fire-interval) and variable, controlled by a complex interaction among topography, site and environmental variables, which could increase resilience to climate change.

Chapter 2) Classified and mapped fuel characteristics (fuelbeds) and fire potentials across a low-frequency, high-severity fire regime (Mount Rainier National Park) using a combination of field data, LiDAR, and climate data. Using this examination at high-resolution, Kopper identified higher fuel loadings and fire potentials on the west side of the Park that could eventually indicate greater impacts and changes there, although the effects of climate change are more certain and will come sooner on the east side.

Chapter 3) Reviewed bottom-up controls (topography and fuels) on fire frequency across the continuum of moist, high-severity fire regimes to dry, low-severity fire regimes from the west side of the Olympic Mountains to the east side of the north and central Cascades. Using this examination, Kopper identified and described a corresponding “fuel management continuum” to inform wildfire and forest management strategies.

D. Future Direction

The North Cascades Fire Management program had a year of transition in 2023. A new Fire Management Officer started in the summer, the Assistant FMO moved to GLAC at the end of the summer, and the Fire Ecologist transitioned to the Northeast Region at the end of 2023. Additionally, the seasonal lead fire effects monitor who has been filling behind the permanent monitor (detailed for 3rd year) was promoted to a year-round term position.

Amidst these changes in staffing at NOCA, the fire effects monitoring program is expanding in 2024. The term lead and three base-funded seasonal fire effects monitors (1 GS-6 and 2 GS-5s) will be accompanied by two additional temporary fire effects monitoring crew members (1 GS-6 and 1 GS-5) to continue to conduct whitebark pine restoration activities funded through the Sourdough, Chilliwack and Lone Mountain BAER projects.

E. References, Links, and Additional Reading

Kopper 2022. Fire Regimes in National Parks of the Pacific Northwest. Implications for Climate Change. PhD Dissertation. University of Washington.

Schuurman et al. 2020. Resist-Accept-Direct (RAD)—A Framework for the 21st-century Natural Resource Manager. NPS/NRSS/CCRP/NRR – 2020/ 2213. NPS Fort Collins, CO

Appendix A. Staffing and Accomplishments

Table A-1. Fire Ecology Staffing 2023

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	Training and Development
Karen Kopper Fire Ecologist	1/1/2023	12/17/23	26	Learned new skills as the BAER Implementation leader for the Chilliwack, Sourdough and Bear Creek fires.
Kate Patronik Lead Fire Effects Monitor	4/15/2023	n/a	18	Term position started 11/4, Women in Wildland Fire Workshop, Selkirk TREX, FIRB taskbook initiated, FBAT Assignments, N-9042 (resource advisor), RT-130
Isaac Comcowich Asst. Lead Fire Effects Monitor	5/12/2023	10/26/2023	12	Columbia TREX, FBAT assignments, N-9042 (resource advisor), RT-130, FEMO taskbook completed
Bella Myrah SCA Intern	4/28/2023	10/26/2023	10	N-9042 (resource advisor), FEMO task book initiated, Selkirk TREX, RT-130
Stella Cook SCA Intern	5/12/2023	10/26/2023	10	Guard School, FFT2 assignment

Table A-2. Fire Ecologist 2023 Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	15	Reviewed and contributed to SAJH and MORA FMP revisions. Continued work on NOCA westside fuel treatment planning for FMP revision.
Presentations	7	Presented west-side fire ecology and other dissertation work at Carhart Wilderness Meeting, 4 Fire refreshers, 4 Resource Meetings, and 2 fire management conferences.
Meetings/task groups	15	Implementation leader for Chilliwack, Sourdough and Bear Creek fires. Lead weekly meetings for Diablo Post-fire protection, and monthly BAER projects. Cadre member for the RX-510 Advanced fire effects course at NAFRI in Tucson, AZ.
Wildfire assignments	10	Lead READ for 1 PP and member of Sourdough fire BAER team for 2 PPs
Prescribed fire/fuels treatment projects	3	Sourdough fire BAER field work – inventorying whitebark pine, fire ecology work for old-growth assessment
Research	10	Assist with fire behavior modeling for NOCA thinning prescriptions. Research on whitebark pine revegetation
Field work/data collection	10	Data preparation for whitebark pine BAER work and fire effects CBI data collection.
Data management	4	Estimated amount of time spent entering data from paper to FFI database, managing data in FFI, preparing and/or archiving data, and/or conducting quality control activities
Data analysis	5	Supervised in data analyses for fire effects reports

Category	Percent Time	Accomplishments and/or areas of activities
Supervision/ admin tasks	20	Hiring, supervision, payroll, travel authorization/vouchers, purchasing, etc.
Training	1	mandatory NPS security and supervisory trainings

Table A-3. Fire Effects Crew 2023 Accomplishments/Focus Areas

Category	Percent Time	Notes
Data collection	48	FMH plots, RAP, CBI plots
Wildfire assignments	15	FBAT assignments on Lookout Fire
Prescribed fire/fuels treatment projects	15	2 spring RX burns (1 LARO, 1 NOCA) REAF-t on Sourdough Selkirk and Columbia TREX
Data entry/management	7	Managing data in FFI, preparing or archiving data, transferring data from tablet to computer
Data analysis	2	Time spent assisting Fire Ecologist in data analysis tasks (Year end report)
Administrative activities	5	Payroll, travel authorization/voucher, NOCA orientation, DOI talent trainings
Training	5	RT-130 – Fire Refresher N-9042 – Resource Advisor S-130/190, L-180
Miscellaneous	3	Escorting crews into burn areas for BAER data

Appendix B. History of Fire Effects Monitoring Plots

Table B-1. All Fire Effects Plots Established

Park	Monitoring Unit	Plot Type	Pre-burn 2023	Immed. Post 2023	Postburn (1-20 yrs) 2023	Annual Total (2023)	Total Plots
North Cascades NP	Stehekin Valley FFRA: Mixed Conifer	FMH Forest	0	0	13	13	52
	Stehekin Valley Contours (Open/Mid/Closed Canopy Mixed Conifer)	FMH Forest	0	0	0	0	23
	Chilliwack Complex	CBI	0	0	24	24	24
	Douglas Fir/ Western Hemlock/ Western Red Cedar	Westside Fuels Reduction	0	2	0	2	6
Lake Roosevelt NRA	Ponderosa Pine/ Common Snowberry Forest	FMH Forest	0	3	11	14	63
	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	6
	Douglas Fir/ Lodgepole (permanent RAPS plots)	Rapid Assessment	0	0	2	2	4
	Annual Brome Grasses	FMH Grass	0	0	0	0	10
	Coastal Prairie Grassland	FMH Grass	0	0	0	0	12
John Day Fossil Beds NM	Big Sagebrush/Bunchgrass	FMH Brush	0	0	0	0	21
	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 NHS	Giant Wild Rye Meadow Restoration	FMH Grass	0	0	0	0	5
Total			0	5	50	55	238