



Interior Region 11 (Alaska) National Park Service Fire Ecology Annual Report: Calendar Year 2021



Interior Region 11 (Alaska) National Park Service Fire Ecology Annual Report: Calendar Year 2021

Authors: Jennifer L Barnes and Jennifer L Hrobak

National Park Service
Alaska Regional Office
4175 Geist Rd
Fairbanks, AK 99709

Please cite this report as:

Barnes, J. L. and J. L. Hrobak. 2022. Interior Region 11 (Alaska) National Park Service Fire Ecology Annual Report: Calendar Year 2021. Unpublished Report. 31 pp. National Park Service, Fairbanks, Alaska. IRMA Link: <https://irma.nps.gov/DataStore/Reference/Profile/2294963>

ON THE COVER

Field crew member checking out a newly germinating white spruce seedling in a fuels monitoring plot in Denali. A mast cone crop of white spruce in 2020 may provide a great source of new white spruce seedlings at the Denali Headquarters area. NPS Photo, Jennifer Barnes

Contents

	Page
A. Summary	5
Overview of 2021 Fire Ecology Program	5
2021 Fire Season and Fuel Treatments	6
B. Science & Monitoring	8
Wrangell-St. Elias Headquarters Fuels Treatment	12
Denali Headquarters Fuels Treatment.....	15
Denali FY21 Treatments and Terrestrial Lidar	18
Yukon-Charley Rivers – Andrew Creek 3 years Post-Fire (NPS Reserve Fund)	18
Fuel Moisture Monitoring	21
Data Management.....	21
C. Research & Technology	22
D. Outreach and Communicating Results.....	22
E. Planning and Compliance.....	23
F. Fire Ecology Accomplishments and Areas of Focus.....	24
Fire Ecology Staffing 2021	24
Regional Fire Ecologists Accomplishments/Focus Areas.....	24
Assistant Fire Ecologist Accomplishments/Focus Areas	26
G. 2022 Fire Ecology Program Direction	27
H. Overall Data Entry Status and FFI Suggestions.....	28
Data Entry Status.....	28
FFI Suggestions	29
References.....	29
Appendix A. Reports, Publications, or Presentations Completed in 2021.....	30

National Park Service Interior Region 11(Alaska) Fire Ecology Annual Report: Calendar Year 2021

Jennifer L Barnes

Jennifer L Hrobak

A. Summary

Overview of 2021 Fire Ecology Program

This annual report provides a summary of 2021 fire ecology projects, activities, and fire season for the National Park Service (NPS) Interior Region 11 in Alaska. The purpose of the fire ecology program is to provide science-based information to guide fire and land management planning, decisions, and practices to maintain and understand fire-adapted ecosystems in Alaska. Preliminary results of monitoring and research are provided for management purposes.

The NPS Alaska Region (AKR) fire ecology program had a busy field season monitoring fuels treatment sites in Denali National Park & Preserve and Wrangell-St. Elias National Park & Preserve, utilizing new terrestrial lidar scanner technology, and assessing a structure-from-motion derived landcover maps in a three-year old burn in Yukon-Charley Rivers National Preserve. The Alaska NPS fire program was able to hire two fire effects biological technicians, the first time since the fire ecology program started in Alaska. The fire effects monitors and fuels crew worked hard to measure over 67 plots in 2021 (Figure 1). The fire ecologists and nearly all the fire staff responded to fire assignments in Alaska or the Lower 48. In addition to leading 4 field projects, the regional fire ecologists provided input on fuels treatment activities, risk assessments, wrote resource briefs, published papers, taught classes, and participated on committees.



Figure 1. Field crew monitoring long term fuels treatment plots at Wrangell-St Elias headquarters. Monitoring helps shape the treatment prescription. Photo taken July 2021. NPS photo.

2021 Fire Season and Fuel Treatments



Figure 2. Mosaic of burn severities on the Cultas Creek fire in Yukon-Charley Rivers National Preserve on June 29, 2021. Photo NPS, Nick Thompson.

The 2021 fire season was relatively quiet in Alaska with 389 fires and only 254,500 acres burned, well below the 10-year average of 1.18 million acres and 547 fires (AICC Seasonal Summary 2021). The fire season started in April with 24 human caused fires and continued into May as the snowpack began to melt in northern areas of the state. Most of the lightning caused fires started in June and July following brief periods of lightning activity (Jun 16-19, Jun 22, Jul 19, Jul 23). A short stretch of warm and dry weather over the Interior occurred from late June through mid-July, allowing some fires to grow. Northwest Alaska was particularly wet and cool through most of

the 2021 summer, although a brief period of dry weather and lightning ignited several fires in late June, these were soon extinguished by precipitation. The wetter and cooler weather spread across the Interior in early August to effectively end the fire season.

Although statewide the number of fires and area burned were below average in Alaska, a few park experienced more fire, particularly Yukon-Charley Rivers and Noatak National Preserve. Overall, 18 wildfires burned within the administrative boundaries of five park units and burned a total of 62,183 acres, 60,988 acres of which burned on NPS managed lands (Table 1). Lightning activity in late June in western Alaska started 8 fires in the parks, 6 fires in Noatak and one fire each in Cape Krusenstern and Bering Land Bridge. Significant rain events extinguished these fires by the first week of July. The largest park fire in 2021 was the Cultas Creek fire in Yukon-Charley Rivers which burned 40,450 acres (Figure 2). Yukon-Charley had 7 fires in or near the park with several fires starting later in July. The fire history map highlights all the 2021 fires in Alaska (Figure 3).

In 2021, the two NPS area fire management programs completed several fuel treatment projects including thinning, lop and scatter, hand piling debris, and pile burns (Table 1). Fuels treatments are implemented to reduce the potential impacts of wildfires on infrastructure and values of concern in the parks. NPS Western Area Fire Management (AWAFM) implemented mechanical fuels reduction at both front country and back country sites, for a total of 7 acres thinned and 21 acres of material burned within Denali National Park and Preserve. NPS Eastern Area Fire Management (EAFM) treated 6 acres at back country sites and burned piles at Ben Creek Complex in Yukon-Charley Rivers NPr. At Wrangell-St. Elias NPPr fuels treatment debris piles were burned at the park headquarters, Slana Ranger Station, and several back country sites for a total of 15 acres burned. Four acres of back country sites were thinned or lop/scattered in Wrangell's during 2021.

Table 1. Wildfires, fuels treatments and prescribed fires in Alaska park units for 2021.

Park Unit	Number of Wildfires ¹	Total Acres Burned ¹	Number of Wildfires Started on NPS Lands ²	Acres Burned on NPS Lands ²	Acres of Fuels Treated (Thin or Lop/Scatter) ³	Acres of Prescribed Fires (Pile Burns) ⁴
Bering Land Bridge	1	1.4	1	1.4	-	-
Cape Krusenstern	1	16.4	1	16.4	-	-
Denali	-	-	-	-	7	21
Gates of the Arctic	-	-	-	-	-	-
Noatak	6	19,124	5	19,062	-	-
Wrangell-St. Elias	3	0.3	1	0.1	4	15
Yukon-Charley Rivers	7	43,041	4	41,909	6	1
Total for Region	18	62,183.5	12	60,988.5	17	37

¹ Includes total number of fires and acres of all wildfires that burned within or partially within the boundaries of the park unit. NPS boundaries include inholdings of lands not owned or managed by NPS. ² Number of wildfire ignitions and acres burned on NPS owned lands. ³ Acres fuels treatment for thinning or lop/scatter as reported in NFPORS, hand-piling not included. ⁴ Acres of pile burns based on acreage of original fuels reduction area.

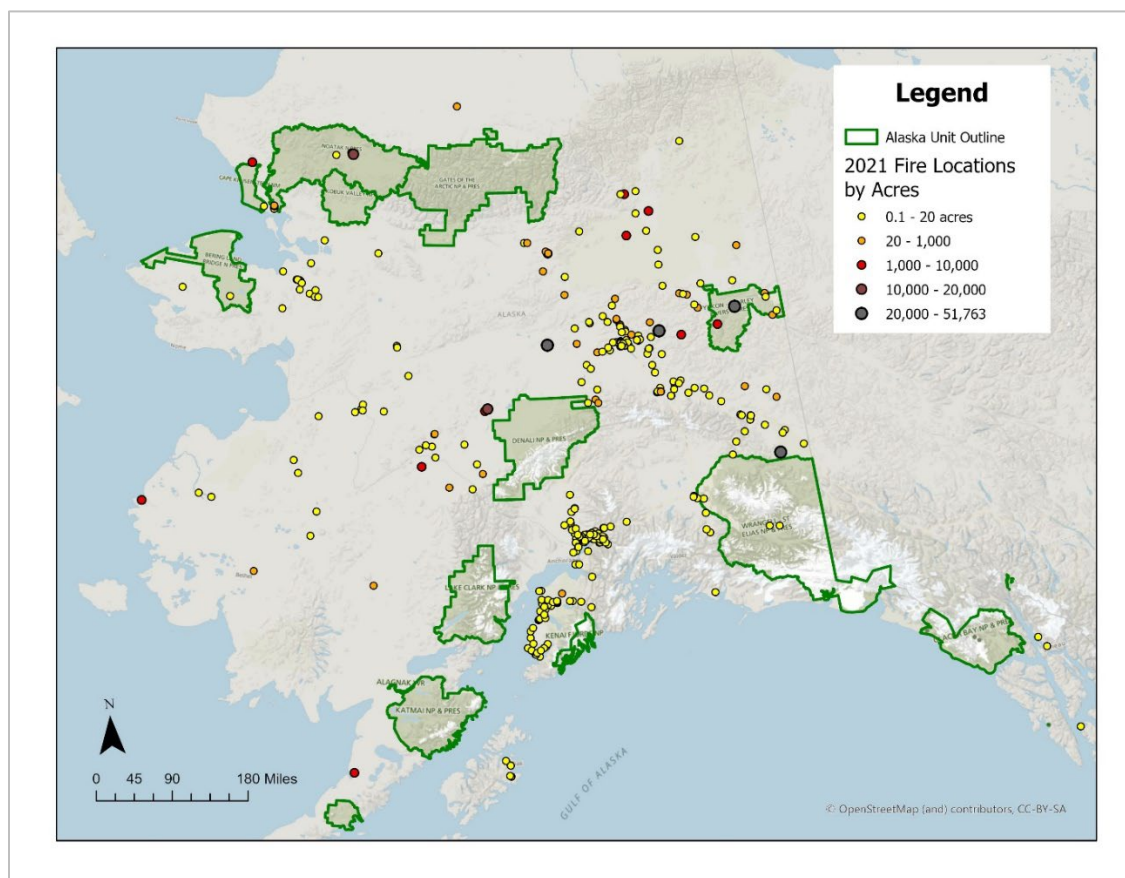


Figure 3. Map of all 2021 fire locations in Alaska, scaled by size of fire. In 2021, twelve fires occurred, and 60,988 acres burned on NPS lands in Alaska, despite the relatively wet summer.

B. Science & Monitoring

Science and monitoring are utilized by the fire ecology program to provide feedback to the NPS fire management program on activities such as fuels treatments and to continue to gain a better understanding of the effects of wildfire on the landscape. Table 2 provides a list of the number of fire/fuels monitoring or inventory plots established in Alaska parks since 2001 through 2021. Over 1000 field plots have been measured by the program over the last 20 years. These plots are also shown on the NPS Alaska – Fire Ecology Plots Map, including the number of plots by park and type of plot data (Figure 4). Data from these sites are used to assess burn severity, monitor vegetation, and assess soil changes after wildfires, or assess fuels treatment effectiveness and vegetation regrowth.

During 2021 the NPS Alaska fire ecology program measured 46 fuels treatment plots in Denali front country area, 19 fuels treatment plots at Wrangell-St. Elias headquarters, and 6 plots fuels plots at a back country cabin site in Yukon-Charley Rivers Preserve. Aerial assessments of vegetation cover and vegetation classifications were made at 80 sites in the 2018 Andrew Creek fire in Yukon-Charley Rivers. Brief descriptions and results of these activities are provided below.

Table 2. Fire effects and fuels treatment (TX) plot workload (2021) and total plots measured 2001-2021.

Park	Monitoring Unit	Type of Plot (FMH, photo point, other)	Pre-burn/TX 2021	1yr Post 2021	2-40 yrs Post 2021	Annual Total (2021)	Total Plots
Lake Clark	2013 Currant Cr Fire	CBI & Cover					43
	2013 Currant Cr Fire	AKR Fire & Fuels Plots					10
	2013 Kristin Cr Fire	CBI & Cover					7
Wrangell-St. Elias	Carl Cr RX	AKR Carl Cr Plots					29
	2009 Chakina Fire	CBI & Cover					57
	2009 Chakina/2016 Steamboat Fires - Reburns	CBI, AKR Fire & Fuels Plots					49
	Chokosna Hazard Fuels Plots - TX	AKR Hazard Fuels Plots					13
	WRST Headquarters TX	AKR Hazard Fuels Plots			19	19	19
	Fire Effects – Paired Plots	AKR Paired Plots					2
	McCarthy University Subdivision TX	AKR Hazard Fuels Plots					27
Yukon-Charley Rivers	2004 Woodchopper/ Edwards Cr Fires	AKR Fire & Fuels Plots					8
	1999 Witch Fire	Fire Effects (Other)					15
	Fire Effects – Paired Plots	AKR Paired Plots					5
	1999 Fires Landcover-CBI	CBI					119
		CBI, AKR Fire & Fuels Plots					31
	2005 Backcountry Cabins - TX	AKR Hazard Fuels Plots			6	6	42
	2018 Andrew Creek Fire-Aerial Assessment	Inventory – aerial assessment (Other)			80	80	80
	2018 Andrew Cr Fire	CBI & CAKN Vegetation					28

Park	Monitoring Unit	Type of Plot (FMH, photo point, other)	Pre-burn/TX 2021	1yr Post 2021	2-40 yrs Post 2021	Annual Total (2021)	Total Plots
Denali	Headquarters – TX	AKR Hazard Fuels Plots			23	23	28
	FY21 Fuels TX	AKR Fire & Fuels Plots	23			23	23
	DENA-VDM	AKR Fire & Fuels Plots					43
	2000-2001 Fires CBI	CBI					84
	2001 Landcover-CBI & Reburns	AKR Fire & Fuels Plots					55
	2009 CAKN Bear Cr Fire	CBI & Cover					28
	2013 CAKN Beaver Log Fire	CBI & Cover					13
	2013 CAKN Toklat River East Fire	CBI & Cover					25
Noatak	2002 Fires – Cottonwood/Uyon	CBI & Cover					40
	2010 Fires	CBI & Cover					34
	2004 Uvgoon Fire	AKR Fire & Fuels Plots					6
	2012 Uvgoon/ Kungiakrok Fires	CBI & Cover					22
	1977 Fires Racine Plots	Racine Plots					8
Bering Land Bridge	1977 Fire Racine Plots	Racine Plots					8
	Fairhaven Ditch Cabins-TX	AKR Hazard Fuels Plots					4
	2002 Mile Post 85 Fire	CBI & Cover					53
Total			23	0	109	132	1,058

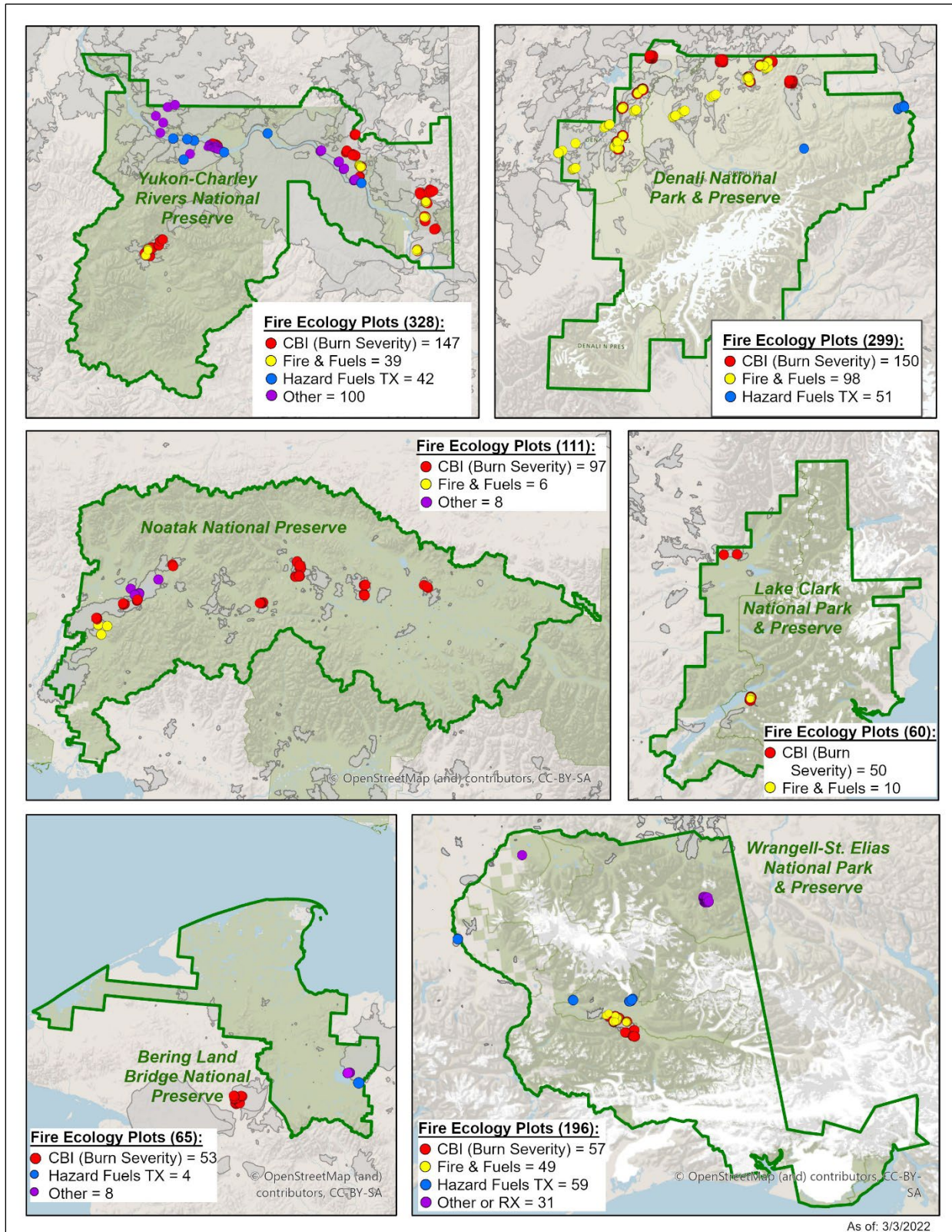


Figure 4. Map of fire and fuels field plots (by type) measured since 2001 within Alaska NPS park units. Fire history of large fires shown in light grey.

Table 3. Management Objectives and Monitoring Results. A summary of the management and ecological objectives for 2021 projects are presented in this table. All results shown are 80% confidence intervals of the mean. An underlined number of plots indicates that the minimum sample size has been attained for that variable.

Monitoring Unit	Management Objective	Monitoring Results (80% Confidence Interval)	Objective Achieved?	Years included in analysis
WRST Headquarters Fuels Treatment	Reduce spruce tree density to 5 to 8 foot crown spacing in spruce (360-681 spruce/acre) (+/- 80% confidence interval).	<u>Spruce Tree Density (n=13 plots)</u> <i>Pre-treatment:</i> 2639 (1474-3804) trees/acre <i>1 yr Post-treatment:</i> 954 (614 - 1293) trees/acre <i>5 yrs Post-treatment:</i> 957 (639 - 1274) trees/acre <i>1 yr Post 2nd Treatment:</i> 580 (451 – 709) trees/acre	YES, average was 580 trees/acre ~ 6 ft crown spacing	2021 (2009-2021)
	Limb spruce to 6 ft (1.82 m)	<u>Dead Ladder Fuel height</u> <i>Pre-treatment (n=35 trees):</i> 0.018 m (0.005 – 0.031 m) <i>1 yr Post-treatment (n=49 trees):</i> 0.868 m (0.746 – 0.989 m) <i>5 yrs Post-treatment (n=41 trees):</i> 1.437 m (1.135 – 1.739 m) <i>1 yr Post 2nd Treat (n=40 trees):</i> 1.104 m (1.009 – 1.198 m)	2021 average was 3.6 ft limb height.	2021 (2009-2021)
DENA 2004 Headquarters Fuels Treatment	Treated spruce density: Zone 2: ~30 foot spruce crown spacing; < 50 spruce tree/acre	<u>Spruce Tree Density Zone 2</u> <i>Pre-treatment (n=5 plots):</i> 889 (593-1187) trees/acre <i>1 yr Post-treatment (n=5 plots):</i> 221 (70-373) trees/acre <i>5 yrs Post-treatment (n=5 plots):</i> 193 (68-318) trees/acre <i>17 yrs Post-treatment (n=5 plots):</i> 399 (151-646) trees/acre	2021 average was 889 spruce trees/acre ~ 11 ft bole spacing	2021 (2003-2021)
	Zone 3: ~20 foot spruce crown spacing; <110 spruce tree/acre	<u>Spruce Tree Density Zone 3</u> <i>Pre-treatment (n=5 plots):</i> 1027 (735-1318) trees/acre <i>1 yr Post-treatment (n=11 plots):</i> 388 (263-513) trees/acre <i>5 yrs Post-treatment (n=11 plots):</i> 337 (232-441) trees/acre <i>17 yrs Post-treatment (n=12 plots):</i> 419 (261-578) trees/acre	2021 average 419 trees/acre ~ 10 ft bole spacing	2021 (2003-2021)
	Limb spruce to 6 ft (183 cm)	<u>Dead Ladder Fuel height</u> <i>Pre-treatment (n=71 trees):</i> 20 cm <i>1 yr Post-treatment (n=118 trees):</i> 32 cm <i>5 yrs Post-treatment (n=122 trees):</i> 33 cm <i>17 yrs Post-treatment (n=122 trees):</i> 50 cm	2021 limb heights were increased, but below target, average was 1.6 ft	2021 (2003-2021)

Wrangell-St. Elias Headquarters Fuels Treatment

This project is part of a long-term fuel mitigation plan for the Wrangell-St. Elias National Park & Preserve (WRST) Headquarters and Visitor Center area that began in 2009. The park headquarters is in a natural boreal forest in south central Alaska, dominated by areas of dense white spruce and mature white spruce with aspen with old wildfire evidence in the area. The fire management program originally created a 100-foot-wide shaded fuel break around the WRST Headquarters, Visitor Center, and access roads in 2010 and retreated the area in 2019-2020. Shaded fuel breaks are intended to reduce the risk of crown fire by increasing the space between spruce trees and reducing ladder fuels. The remaining trees provide shade which keeps the ground cooler and reduces the growth of more flammable understory vegetation such as grasses and shrubs. The thinning treatment was planned to be completed in several phases, to minimize wind-throw and tree stress.

The goals for the **first phase** were as follows and treatment was implemented in 2010 and 2011:

1. Cut spruce to establish 3-to-5-foot crown spacing (approximately 681-1210 spruce/acre)
2. Maintain a mixed age stand
3. All sizes of healthy deciduous trees remain
4. Average height to ladder fuels will be approximately 4 feet

The goals for the **second phase** were as follows and treatment was implemented in 2019 and 2020:

1. Cut spruce to establish 5-to-8-foot crown spacing (approximately 360 -681 spruce/acre)
2. Maintain a mixed age stand
3. All sizes of healthy deciduous trees remain
4. Average height to ladder fuels will be approximately 6 foot limb height above ground.
5. Remove all large dead and down woody fuels.

The NPS fire ecology program monitored the fuels treatment area prior to treatment (2009), 1 year after the first treatment (2011), followed by a 5-year re-measurement (2015), and 11-year re-measurement in 2021 after the second treatment. Thirteen treatment plots and six control plots were established. The monitoring data has been used to assess the effectiveness of the treatment, measure vegetation re-growth, monitor for invasive weeds or other impacts of the thinning. Forest types at the site include closed canopy (>60% cover) dense small diameter white spruce (Fig. 5), open canopy (30-60%) large diameter white spruce (Fig. 6), and open canopy white spruce-aspen forests.



Fig. 5. Dense white spruce along the road into the Wrangell St. Elias headquarters and visitor center were thinned and limbed in 2010 and 2020 to provide a fuel break in the event of a wildfire. Photos from a monitoring plot (TX-06) show from left to right, pre-treatment (2009), 1 year post treatment (2011), and 11 years post treatment (2021).



Fig. 6. Open canopy white spruce forests near the Wrangell St. Elias headquarters and visitor center were thinned and limbed in 2010 and 2020 to provide a fuel break in the event of a wildfire. Photos from a monitoring plot (TX-11) show from left to right, pre-treatment (2009), 1 year post treatment (2011), and 11 years post treatment (2021).

WRST HQ Preliminary Results

The second entry fuels treatment at WRST headquarters reduced the spruce tree density from an average of 957 spruce trees/acre in 2016 to 580 trees/acre in 2021, and successfully met the objective of increasing the crown spacing between spruce trees to reduce crown fire potential. The 5-to-8-foot crown spacing prescription should result in approximately 360-680 spruce trees/acre. Prior to thinning, the average spruce tree density was 2,639 spruce trees/acre (Figure 7, Table 3). Most of the spruce were removed from the closed canopy spruce forests (see Fig 5), which were the most flammable sites. The treatment opened the canopy which should reduce the potential for crown fire.

Healthy deciduous trees (aspen and balsam poplars) were retained on site and there was minimal change in deciduous tree density at the plots one year after the treatment (Fig. 7). However, some aspen and balsam poplars were cut during the treatment if decay was evident, and small aspen and balsam poplar re-sprouts were observed 1 year post treatment. By 5 years post treatment the aspen and poplar suckers were tall enough to be tallied as trees (>4.5 feet height) in many of the plots. The density of deciduous trees increased from an average of 50 trees/acre pre-treatment and one year post treatment, to 503 trees/acre (80% CI 258-748) five years after the treatment (Fig. 5). Many of these young saplings were cut during the re-treatment in 2019-20, resulting in a decrease in deciduous tree density in 2021. In general aspen and balsam poplar are less flammable than spruce, so this change will likely contribute to creating a better fuel break.

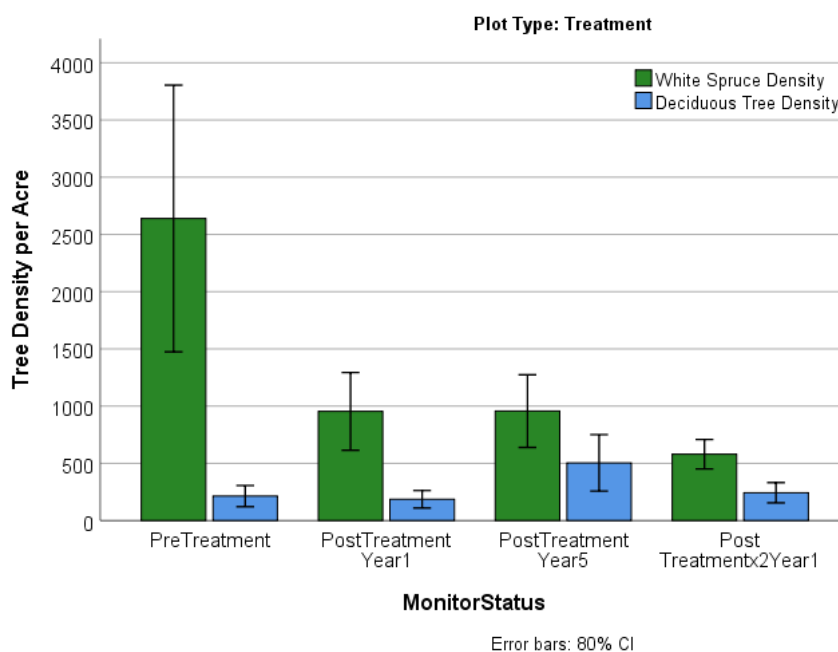


Figure 7. Average density (trees per acre) of spruce (green bars) and deciduous trees (blue bars) at treatment plots for pre-treatment (2009), 1 year post-treatment (2011), 5 years post-treatment (2015), and 1 year post 2nd treatment (2021) at the Wrangell-St. Elias Headquarters mechanical fuels site. (80% CI error bars).

The two-phase fuels treatment significantly improved the ladder fuel heights at the site. Prior to treatment the average height from the ground to the lowest dead branches on spruce trees was less than 1 inch (1.5 cm) above the ground. In 2015 the average height to the lowest dead branches on spruce trees was 4.9 feet (143 cm), which achieved the original objective of the 4 ft limbing height prescription (Table 3). The average dead ladder fuel height in 2021 averaged 3.6 feet and was less than the intended height of 6 feet. See discussion below for the Denali fuels treatment about different measurements of limb and crown heights.

WRST HQ Treatment Recommendations: Thinning treatment targets were met. Additional limbing at the WRST HQ fuels treatment site would be recommended. Fire behavior modeling analyses will be completed in 2022-23.

Denali Headquarters Fuels Treatment

Denali National Park & Preserve implemented one of the first large-scale fuels treatments projects around structures for the park service units in Alaska in 2004. Approximately 23 acres were treated around the Denali Headquarters, NPS Employee Housing, C-Camp, and Wilderness Access Center (WAC). The purpose of the thinning treatment was to create defensible space around park front country infrastructure and to diminish wildland fire risk, while minimizing visual and ecological impacts. The most intensive thinning treatment was applied closest to buildings; Zone 2 (High thinning: 0-30 ft from structure) and Zone 3 (Moderate thinning: 30-100 ft). Additional re-treatment has occurred in some areas of this original treatment unit over the past 10 years. The NPS regional fire ecology program has monitored this fuels treatment site periodically over the past 17 years. Twenty-three monitoring plots were established in 2003 pre-treatment and have been re-measured in 2005 1-year post, 2009 5 years post, and 2021 17-years post treatment.

Fuels treatment prescription parameters monitored from 2004 were:

- Tree density in Zone 2 to less than 50 trees/acre (30 ft bole spacing).
- Tree density in Zone 3 reduced to less than 110 trees/acre (20 ft bole spacing).
- Remaining trees limbed to six foot in both zones.

DENA HQ Preliminary Results

The initial fuels treatment in 2004 reduced the spruce tree densities at the Denali HQ treatment area (Figure 8, Table 3), and densities were still lower than pre-treatment 17 years after the treatment (2021). Prior to treatment, Zone 2 plots averaged 890 spruce trees/acre, and this was reduced to an estimated 221 trees/acre immediately after the treatment in 2005. In 2021 the density had increased to 399 spruce trees/acre. Some of the spruce density increase was due to small trees growing in height (tallied as trees), but other factors such as plot markers not located may contribute to this change. In Zone 3 (30-100 ft from the structures) there was also a reduction in tree density. The average spruce tree density of 1027 spruce trees/acre prior to treatment was reduced to 388 trees/acre one year post treatment and averaged 419 spruce trees/acre in 2021 (Figure 8, Table 3). Based on the plot data, the thinning prescriptions for the two zones were not met originally, nor in 2021. The current density of spruce is closer to an 11-foot bole spacing in Zone 2 and to 10-foot bole spacing in

Zone 3. The original prescription of 20 to 30 foot bole spacing is more aggressive than most treatments in Alaska – where 10-to-12-foot tree spacing is more common.

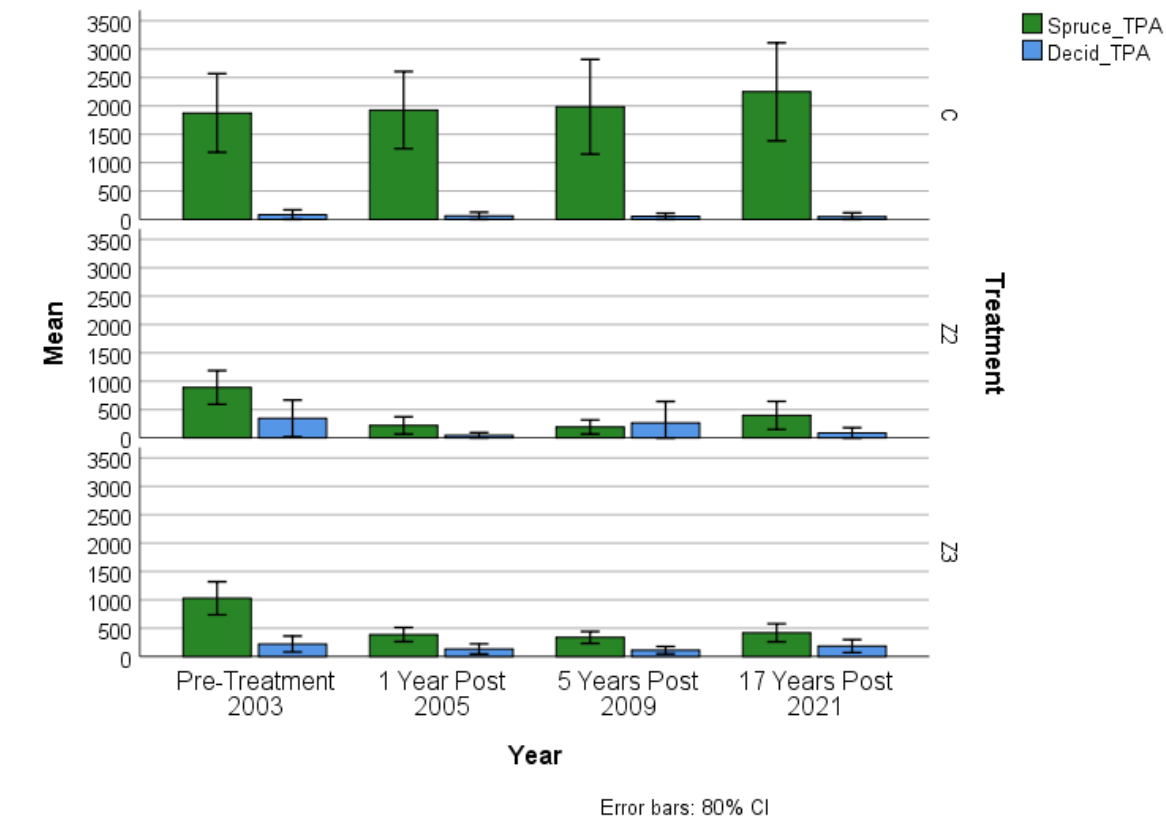


Figure 8. Average density (trees per acre) of spruce (green bars) and deciduous trees (blue bars) at treatment plots for pre-treatment (2003), 1-year post-treatment (2005), 5 years post-treatment (2009), and 17 years post treatment (2021) at the Denali Headquarters mechanical fuels site. Control plots, Zone 2 plots and Zone 3 plots are separated in the graph. (80% CI error bars).

The purpose of tree limbing is to reduce the ladder fuels for surface fire to spread into the crowns of trees. The original fuels treatment prescription for Denali HQ was to limb spruce trees up to 6 feet. Based on the monitoring data the limbing prescription was not met in this fuel treatment unit (Table 3, Figure 9). AKR monitoring protocols (Barnes, McMillan, and Hrobak 2020) include measuring the height above ground to the lowest part of spruce crowns in three places: dead branches, live branches, and main live crown. Figure 9 shows how these attributes vary, with the dead branches being the lowest on the trees. While the treatment increased the limb heights for live and dead branches, generally most trees measured were below 6 ft target for all years. Many of the trees in the park headquarters are larger white spruce and have branches that drape down, even if the limbs are cut to 6 ft, the branches may droop to a lower level (see figure 10). At some plots these branches were not limbed enough and at others, the branches are growing with the opening of the canopy (Figure 10).

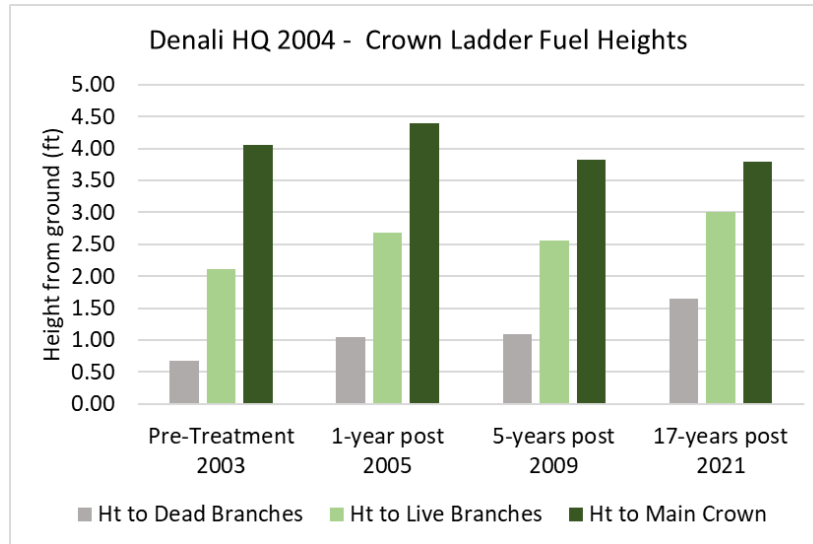


Figure 9. Average height in feet above ground to different spruce crown ladder fuels variables: dead branches (gray bars), live branches (light green), and main crown (dark green) for each monitoring year in the treatment plots at the Denali Headquarters mechanical fuels site.



Figure 10. Monitoring plot near Denali Bus Depot (WAC) shows changes over time since area was thinned and limbed in 2004. The large white spruce on left side of photo was limbed (2005), but the branches are nearly touching the ground by 2009 (5 years post treatment) and more clearly in 2021 photo. The small spruce immediately in front of the building are much taller by 2021.

DENA HQ Treatment Recommendations: Preliminary results from the 2021 monitoring data and observations indicate that additional thinning and limbing are needed for some areas of the original Denali fuels treatment project area. Additional fire behavior modeling will be completed in 2022-23. More empirical case studies of fire behavior should be done in Alaska to determine which part of the tree canopy is the primary carrier of fire from the ground to the crown.

Denali FY21 Treatments and Terrestrial Lidar

NPS Western Area Fire Management has continued to plan and implement fuels reduction projects (thinning/limbing) around the infrastructure of Denali front country. In 2021 plans included thinning around high visitation locations including the Denali Visitor Center, Riley Creek campground, and Admin Camp. To monitor these newer treatments, regional fire ecologist and Denali fire effects and fuels seasonals established 23 pre-treatment plots in the new treatment units in 2021 (Table 2). The pre-treatment plots had an average of 1345 white spruce trees per acre. The planned treatment of 10-foot bole-spacing will result in a density of approximately 435 trees per acre.

Terrestrial Lidar Scans (TLS) were taken at each plot and will be used to assess changes in fuels and forest structure with a 3-D point cloud. Field plot data will be compared to the TLS point clouds to assess this technology, and analyses are in process. For an example of what the TLS imagery looks like see: [Reducing fire risk – treating, burning, and monitoring fuels treatments in Denali and Wrangell-St. Elias headquarters \(U.S. National Park Service\) \(nps.gov\)](#)

Implementation of these FY21 Denali fuels reduction units was initiated in 2021 and will continue over the next couple years. Monitoring these treatments will be important for additional fire planning for the front country of Denali.

Yukon-Charley Rivers – Andrew Creek 3 years Post-Fire (NPS Reserve Fund)

Understanding the effects of climate change and fire are important for future fire management planning in Alaska. The 2018 Andrew Creek fire in Yukon-Charley Rivers National Preserve has provided an ideal location to investigate the short- and long-term effects of fire and climate change on vegetation, permafrost, soils, water quality, and wildlife habitat. The fire occurred in boreal forest along the Yukon River; much of the area was underlain by ice-rich Yedoma permafrost. Prior years' work on this study can be found here: [2020 Fire Ecology Report](#), <https://www.nps.gov/articles/ice-birds-streams-amidst-fire.htm>, or <https://www.nps.gov/articles/000/andrewcreekpostfire.htm>.

In 2021, the AK NPS fire ecology program was funded by the NPS Fire Research Reserve Funds to assess the preliminary post-fire vegetation map utilizing Structure-from-Motion (SfM) imagery that was developed in collaboration with the regional office geologist, Scientist-in-the Park (SIP), CAKN plant ecologists, and regional fire ecologists. In addition, funding was used to service the weather station that was installed within the fire and to re-install a bird sound monitoring station for the summer of 2021.

Structure-from-Motion (SfM) imagery and sub-meter DEMs (32 cm resolution) collected one year after the fire (2019, funded by NPS Reserve Fund Research) was used to prepare a 1-year post fire vegetation map (Figure 11). In 2021, the regional fire ecologist completed an aerial assessment of

the Andrew Creek burn area and collected basic ocular vegetation cover data, recorded vegetation classification, and general severity class (Figure 11). Eighty polygons were flown with a helicopter.

The intent was to utilize the polygons to complete an accuracy assessment of the 1-year post fire SfM vegetation map. In the 3-years since the fire, the vegetation had grown significantly and made the comparison to a 1-year post fire map difficult. Also, because the map was very high resolution (32 cm resolution), multiple map classes were within the assessment polygon areas. However, the data can be used to assess general changes over time from pre-fire vegetation type to 3-year post fire vegetation type as shown in Table 4.

The dominant 3-year post-fire vegetation class sampled was “moderate regeneration cover”, which generally consisted of low shrubs, herbaceous plants, and early successional mosses. This class occurred in low to high severity burn areas, typical of many boreal forest burned areas post fire. Interestingly, the “regen dense cover” class occurred more frequently in high severity sites, this was primarily driven by either dense fire weed, grass or re-sprouting deciduous trees. Additional analyses with this data will occur in the next year.

Although the initial fire effects at Andrew Creek and the thermokarst features observed over the last couple years seem unprecedented, the vegetation changes observed aerially were not unexpected. Understanding whether we see accelerated changes will be important over time.

Table 4. Aerial assessment of the Andrew Creek fire in Yukon-Charley Rivers NPr in 2021. Aerial sites were classified into a 3-year post-fire map class and given an overall burn severity estimate.

3-Year Post Fire General Veg Type	Unburned	Low	Moderate	Mod-High	High	Total Polygons
Birch Forest	5					5
Spruce-Birch Forest	1					1
Spruce Forest		1				1
White Spruce Forest	2					2
Black Spruce Forest	5	2				7
Aspen Forest		1				1
Regen Dense Cover		3	4	2	8	17
Regen Moderate Cover		2	10	6	4	22
Regen Sparse Cover		1	7	1	1	10
Regen Wetland		6	3		1	10
Shrubland	1					1
Tussock-Low Shrub	1					1
Wetland Herbaceous	1	1				2
Total Sites	16	17	24	9	14	80

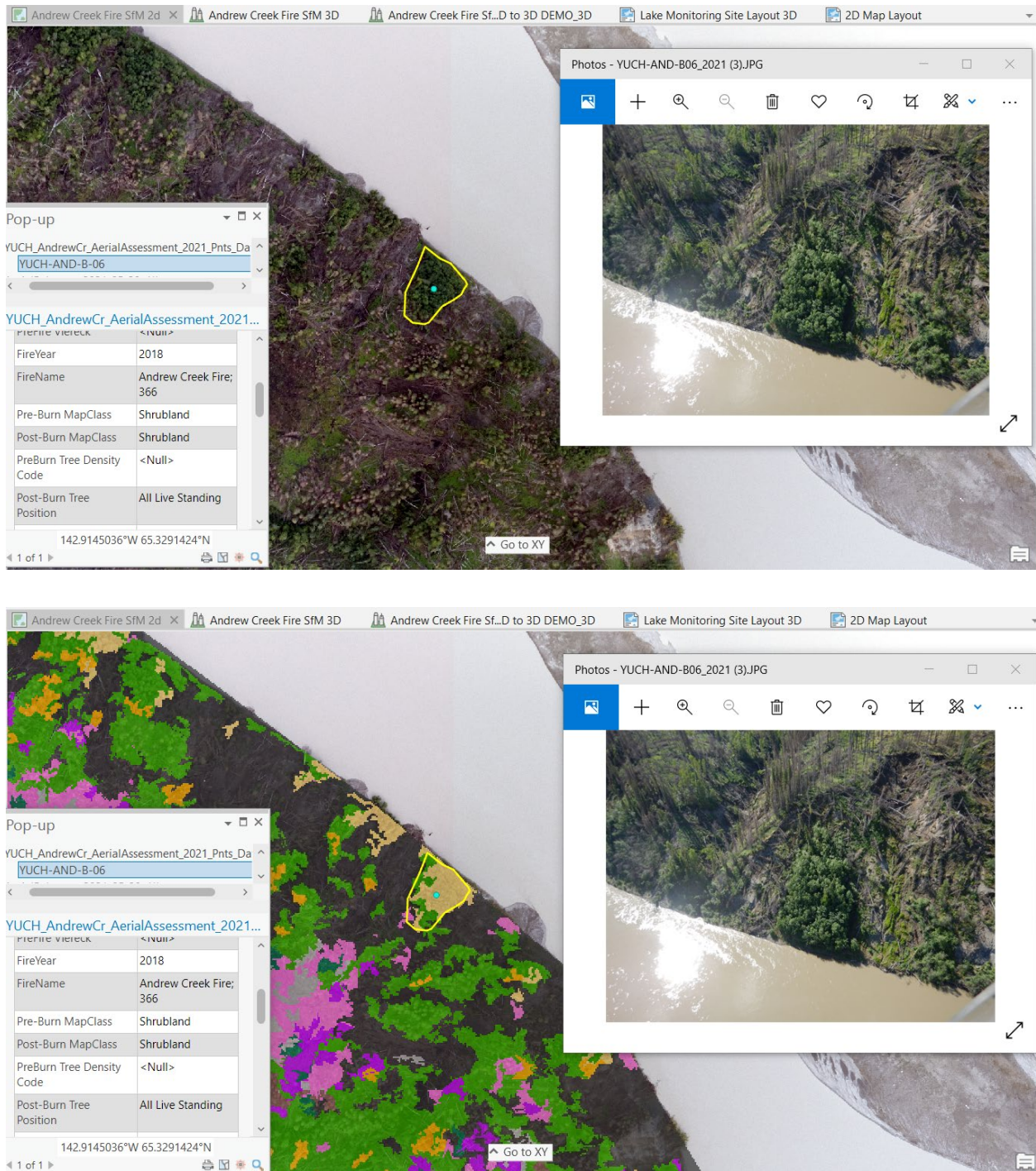


Figure 11. Map of one year post vegetation was prepared using 2019 SfM imagery of the Andrew Creek fire in Yukon-Charley Rivers NP. In 2021, 80 aerial assessment sites were documented with photos and general vegetation data to assess the map product and current state of vegetation at the fire. NPS Map and photos: J. Barnes

Fuel Moisture Monitoring

Duff, foliar and other live fuel moisture samples were collected from May through August of 2021 at the Denali DVC site. Black spruce foliar, Labrador tea, willow, dwarf birch, and bluejoint grass samples were collected to track seasonal moisture trends in common interior plants and provide fuel moisture inputs for fire behavior modeling. Duff moisture samples were collected with the intent to convert the actual % moisture content of the live moss, dead moss and upper duff layers to the corresponding Canadian Forest Fire Danger Rating System (CFFDRS) Fuel Moisture Codes and compare them to the RAWs derived Fuel Moisture Codes (e.g., Fine Fuel Moisture Code, Duff Moisture Code and Drought Code). All the data was entered into local spreadsheets and entered into the [National Fuel Moisture Database](#) (NFMD). NFMD is being converted to a new web-based system called Fire Environment Mapping System (FEMS). Data entry and graphing in NFMD are no longer available, but data can be downloaded from the site.

Data Management

In 2021, all plot data was entered into FFI (FEAT/FIREMON Integrated) - a plot-level monitoring sequel server software tool designed to assist managers with collection, storage and analysis of ecological information (<https://www.frames.gov/ffi/home>). As of December of 2021, all of the Alaska fire ecology FFI databases were migrated to the new FFI Remote Application hosted by the USGS EROS program.

The AK FFI databases and metadata files were also digitally archived on the NPS Data Store IRMA in February 2022. The Alaska Eastern Area fire ecology data set includes data for YUCH and WRST: <https://irma.nps.gov/DataStore/Reference/Profile/2293120>. The Alaska Western Area fire ecology data set includes data for DENA, NOAT, BELA, and LACL: <https://irma.nps.gov/DataStore/Reference/Profile/2293119>. The updated FFI databases reflect the recent data additions and QC to the AK NPS fire ecology databases (Table 5).

Table 5. Monitoring data entered, quality checked, and number of units monitored in 2021.

Park/Project/Database	% 2021 Data Entered	% 2021 Data Quality Checked	# Prescribed Fires Monitored	# Non-fire Fuels Treatments Monitored	# Wildfires Monitored	# BAER Treatments Monitored
Denali FY21 Fuels Treatment/AKWEST	100%	90%	0	1	0	0
Denali HQ Fuels Treatment /AKWEST	100%	90%	0	1	0	0
WRST HQ Fuels Treatment /AKRO	100%	90%	0	1	0	0
YUCH Andrew Creek Aerial Assessments / AKRO	100%	90%	0	0	1	0

C. Research & Technology

Two research proposals were submitted for the FY21 NPS Reserve Fund Research pertaining to fuels treatment effectiveness in Wrangell-St Elias and Denali and a proposal to support additional work on the Andrew Creek fire research in Yukon-Charley Rivers. All three of these parks were included in a proposal for FY22 funding under the Focused Condition Assessments (FCA) to improve the fire history records for these parks.

Both fire ecologists are part of the interagency Fire Research, Development and Application Committee (FRDAC) for the Alaska Wildland Fire Coordinating Group (AWFCG) and are on the advisory board for the JFSP Alaska Fire Science Consortium. The fire ecology program also participates in other interagency research, project specific or technology related groups/teams including the Fire Modeling and Analysis Committee (AFWCG), Conservation of Arctic Flora and Fauna (CAFF) Arctic FIRE project group, Alaska InFORM Technical Review Team, and the Interagency Arctic Research Policy Committee (IARPC) Terrestrial Ecosystems Collaboration Team.

Table 6. Research workload in 2021.

Park	Are research needs identified in FMP or Monitoring Plan?	# of Proposals Submitted in 2021	# of Proposals Funded in 2021	# of Research Projects Supported in 2021 ¹	Additional Comments
Wrangell-St. Elias NPPr	Yes	1	0	1	FCA proposal and Reserve Fund Treatment Effectiveness FY21
Denali NPPr	Yes	1	0	1	FCA proposal and Reserve Fund Treatment Effectiveness FY21
Yukon-Charley Rivers NPr	Yes	1	0	1	FCA proposal FY22 and Reserve Fund Andrew Creek FY21

¹Number of funded research projects, new or ongoing, supported by the fire ecology program including logistical info or support, staffing, etc.

D. Outreach and Communicating Results

Providing updates, presentations, publications, and highlights in a variety of formats is an important part of fire ecology program. A list of reports, presentations, publications, and other forms of communication completed in 2021 by the fire ecology program is provided in Appendix A and a few highlights shown here.

In 2021, the regional fire ecologists co-authored three peer reviewed publications led by other scientists (Baltzer et. al 2021, Holsinger et. al. 2021, Smith et. al. 2021). They helped write a web article highlighting the collaborative monitoring on the 2018 [Andrew Creek fire](#) in Yukon-Charley Rivers NPr. The ecologists wrote short articles/briefs about using new technology with the Terrestrial Lidar Scanner (High Latitude Highlights Fall 2021, NPS Active Forest Management

Brief), and fire success stories about NPS Alaska [fuels treatment work and monitoring](#) in Denali and Wrangell-St. Elias.

A multi-regional educational article about the benefits and challenges of managing fire for kids as part of the Frontier for Young Minds, was published in 2021: “[Rising From the Ashes: The Role of Fires in National Parks](#)” (Sanders et. al. 2021). In addition, a basic [boreal forest fire ecosystem](#) web article was published by the regional fire ecologist, that provides an overview on boreal forests and fire.

Resource briefs were completed in 2021 for the [Arctic Network I&M fire vital sign](#). These briefs highlight how the fire perimeter and fire origin data for the five parks were improved through QC using satellite and other imagery.

Table 7. Communicating Results - 2021

Park	# of Project Monitoring Reports completed in 2021	# of Annual meeting(s) with Park staff	# of Formal presentations of results	Web Articles or Publications	Do you use Minitab?
Yukon-Charley Rivers	0	0	0	2	No
Denali	0	0	0	1	No
Noatak	0	0	0	0	No
Lake Clark	0	0	0	0	No
Wrangell-St. Elias	0	0	1	2	No
Regional Office	0	1	1	0	No
Arctic Inventory & Monitoring Network	1	1	0	1	No

E. Planning and Compliance

The fire ecology program participates in *planning* activities for the Fire Management and Park Land Management Programs. Table 8 has a list of parks with fire management plans and the status for fire monitoring plans and Desired Future Conditions within the plans or other planning documents (e.g. Resource Stewardship Strategies). All fire management plans for Alaska are available on IRMA.

Table 8. Fire Management Plan - Fire Monitoring Plan Status as of 2021

Park	Does Park have written Desired Future Conditions (DFCs)? (yes or no)	Date Park-level Monitoring Plan completed (or revised)	Total # of Project- or Community-level Monitoring Plans	Assisted with how many BAER plans in 2020?
Bering Land Bridge NPr	Yes – Interim Fire Desired Conditions	2012	2	0
Denali NPPr	Yes in RSS	2012	4	0
Gates of the Arctic NPPR	Yes - Interim Fire Desired Conditions in FMP	2014	1	0

Park	Does Park have written Desired Future Conditions (DFCs)? (yes or no)	Date Park-level Monitoring Plan completed (or revised)	Total # of Project- or Community-level Monitoring Plans	Assisted with how many BAER plans in 2020?
Glacier Bay NPPr	Not completed	In Progress	0	0
Katmai NPPr	Yes – Suggested Fire Desired Conditions in FMP	2012	0	0
Lake Clark NPPr	No - Fire Management Objectives in FMP	2010	1	0
Western Arctic National Parklands	Yes - Interim Fire Desired Conditions in FMP	2012	4	0
Wrangell-St. Elias NPPr	No - Fire Management Objectives in FMP	2010	5	0
Yukon-Charley Rivers NPr	No - Fire Management Objectives in FMP	2010	3	0
Klondike Gold Rush National Historic Park	No - WERP to be converted to FMP			
Sitka National Historic Park	No - WERP to be converted to FMP			

F. Fire Ecology Accomplishments and Areas of Focus

Fire Ecology Staffing 2021

The 2021 Alaska NPS Fire Ecology Program included a regional fire ecologist, a subject-to-furlough assistant regional fire ecologist and two seasonal biological technicians (shared with Western Area Fire Program). All fire ecology fieldwork was accomplished with the assistance of the NPS fuels seasonal technicians, biological technicians, and other fire staff under the guidance of the two regional fire ecologists. Table 9 provides an overview of the fire management personnel that worked on or have assisted with fire ecology projects in 2021.

Table 9. Fire Ecology Staffing 2021

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	READ Qualified (Yes or No)	Training and Development
Jennifer Barnes (Regional Fire Ecologist)	1/1/2021	12/31/2021	26	No	
Jennifer Hrobak (Assistant Regional Fire Ecologist)	1/1/2021	12/31/2021	25	No	
Jessica O'Connor (Biological Technician)	5/24/2021	11/18/2021	14	No	
McKinley Nueser (Biological Technician)	4/26/2021	10/6/2021	12	No	

Regional Fire Ecologists Accomplishments/Focus Areas

The Interior 11 (Alaska) Regional Fire Ecologist facilitates planning, monitoring, research and outreach for the *region* and park programs. This position is responsible for monitoring plans, protocol development, compliance, administration, field instruction, field work, data analysis, and reporting on projects for the parks and region. In 2021, the regional fire ecologist analyzed data from

current projects, wrote portions of Fire Management Plans, participated on two Alaska IMT assignments, prepared research proposals, wrote reports, and provided back up to the Regional Fire Management Officer. Table 10 provides a summary of the Regional Fire Ecologist focus areas and accomplishments for the calendar year of 2021.

Table 10. Fire Ecologist 2020 Accomplishments/Focus Areas (J. Barnes).

Category	Percent Time	Accomplishments and/or areas of activities
Planning	15%	Denali, Wrangell-St. Elias, Gates of the Arctic Fire Management Plan revisions RSS – Wrangell-St. Elias Compliance for projects
Presentations/ Reports	15%	Presentations: NPS, Interagency Meetings Annual reports for Fire Ecology program and I&M network Articles for NPS High Latitude Highlights and web articles
NPS Meetings/ task groups	10%	AKRO and Park Fire Meetings Regional Fire Ecologist conference calls I&M Technical Committee meetings Strategic Planning – Climate & Fire task group
Interagency work	10%	AWFCG Fire Research, Development & Application Committee AWFCG Fire Modeling and Application Committee Alaska Fire Science Consortium (Board member) Interagency fire meetings GA Editor for NPS Alaska
Wildfire Assignments	7%	Bootleg Fire - OR (AK Type 1 IMT) – RESL – 16 days McCash Fire – CA (AK Type 1 IMT) – PSC2(t) – 14 days
Prescribed fire projects (implementation)	0	
Non-fire fuels projects (implementation)	0	
Research	5%	Research Projects: • YUCH Andrew Creek – NPS Reserve Fund • WRST/DENA Fuels Treatment Effectiveness – NPS Reserve Fund • DENA/YUCH/WRST Fire History – NPS FCA FY22 Research consultation on various projects
Data collection	10%	Denali Fuels Treatment Wrangell Headquarters Fuels Treatment Yukon-Charley Andrew Creek Assessment
Data entry	2%	Data entry supervision and database assistance QC of data FFI Remote App testing
Data analysis	10%	WRST, DENA and YUCH projects
Supervision/Admin	10%	Supervision STF GS-11 Fire Ecologist Paperwork and administrative (time, travel, email) Budget
Training	2%	Annual NPS Spring Training Virtual, S-490
Travel out-of-park for plot or project work	1%	Field work and fire assignments in 2021.
Miscellaneous	3%	Acting Regional Fire Management Officer

Assistant Fire Ecologist Accomplishments/Focus Areas

The assistant regional fire ecologist works for the regional fire ecologist in Alaska. This position helps plan and implement fire effects and fuels monitoring projects. This position also assists in the development of park fire management plans, fire monitoring plans, and compliance for fire ecology activities.

The primary workload in 2021 focused on planning and execution of 5 field projects in three different parks including compliance, field work planning, data collection, and post-field work processing (data entry, etc.). Other notable accomplishments include writing ARCN Resource Brief (published Feb 2021), managing influx of new NPS Fire GPS devices (15 Samsung Tablets, 3 Trimble R1s and 2 Leica GG04s), and participating in three Type 1 Alaska Incident Management Teams assignments. Table 11 provides a summary of the Assistant Regional Fire Ecologist focus areas and accomplishments for the calendar year of 2021.

Table 11. Assistant Regional Fire Ecologist 2021 Accomplishments/Focus Areas (J. Hrobak).

Category	Percent Time	Accomplishments and/or areas of activities
Planning	25%	Compliance & field work prep for the following projects: – YUCH Andrew Creek Fire – Aerial vegetation/burn severity surveys – YUCH Sam Creek Cabin Hazardous Fuel Treatment Plots – DENA FY21 Hazardous Fuel Treatments Plots – WRST Hazardous Fuel Treatment Plots – DENA 2004 Hazardous Fuel Treatment Plots – 2021 Re-measure – DENA Lidar/TLS at 2004 & FY2021 HZF Plots Annual Field Project Preparation (Trimble updates, Samsung Tablets, InReach Fire Hub development, Trimble R1, Leica, ArcGIS/ArcPro updates, data dictionary editing, gear preparation, COVID mitigation plans, etc) Annual Spring Training Development & Preparation
Presentations/Reports	15%	All presentations listed in Appendix A. (Outreach, Seasonal Training, etc) Fire Ecology Annual Report ARCN Fire Extent & Frequency Resource Brief Virtual Risk Assessment Guide Annual Spring Training Presentations (2) Fire Management & Climate Change Interviews (Strategic Plan – Task 3A) Manuscript Prep (see Appendix A)
NPS Meetings/ task groups	5%	AKRO Fire Staff Meetings (weekly) AKRO Ranger Services Meetings (twice a month) Interior Region 11 Fire Management Meetings (monthly) Regional Fire Ecologist Meetings (alternate) AKRO Fire In-Person Staff Meetings (semiannual) Miscellaneous Project Meetings Leadership Coffee Meetings
Interagency Work	8%	Alaska Fire Science Consortium – Advisory Board Member AWFCG Fire Research, Development & Application Committee AWFCG GIS Committee (Alternate) AWFCG Fire Modeling and Analysis Committee (Participant)

Category	Percent Time	Accomplishments and/or areas of activities
		Alaska Incident Management Team, Logistics Section Meetings/IMRR Alaska Interagency Fall Fire Review Alaska Fire Science Consortium Workshops NPS Representative for IARPC InFORM Tech Review Group & AOP Revisions Group
Wildfire Assignments	12%	AK IMT Mobilization Coordinator Bootleg Fire - OR (AK Type 1 IMT) – BCMG (t) Monument Fire – CA (AK Type 1 IMT) – BCMG (t) McCash Fire – CA (AK Type 1 IMT) – BCMG (Acting Facilities Lead)
Prescribed fire projects	1%	Slana RX Pile Burn (WRST)
Non-fire fuels projects	0%	
Research	0%	
Data Collection	5%	Fuel Moisture Sampling in Fairbanks YUCH, WRST, and DENA field projects (see list in Planning Category)
Data Entry/Processing	10%	FFI Data Entry & QC Fuel Moisture Sampling Data Entry
Data Analysis	2%	ARCN Protocol – Fire Extent & Frequency fire history QC and data analysis
Supervision/Admin	4%	Quick Time, Travel Authorizations/Vouchers, Credit Card Statements, Email, etc. Hiring for 2 seasonal Bio Techs (shared between Fire Ecology & AWAFM) Interview panel for EAFM Fuels Specialist
Training	10%	Aviation Courses (A-302) RT-130 Shotgun Certification/Bear Safety ArcGIS Pro – NPS DOI Talent Courses DOI Required Courses Provided Instruction and/or training materials for: – Risk Assessments (using Samsung Tablets & Collector) – Fuel Treatment Collector App – Fuel Moisture Sampling (NPS Only) – FFI Training (NPS Only) – AK Logistics – InReach Device – FireNet (Teams/Sharepoint/Shared Inbox) – for Logistics section – AWAFM Fire Ecology Field Training Day
Travel out-of-park for plot or project work	3%	Travel to L-48 for IMT fire assignments Travel in Alaska for field work/prescribed fire
Miscellaneous		

G. 2022 Fire Ecology Program Direction

The primary goals and direction for 2022 include writing up technical reports or publications from past field work. Planning work includes assisting with revisions of Fire Management Plans and compliance for all field work. Field work planned for this year include measuring and re-measuring

fuels treatment plots at Wrangell-St. Elias and Denali and establishing fuels treatment monitoring plots in Katmai. See lists below for the proposed direction for the R11 fire ecology program for 2022.

Planning

- Fire Monitoring Plan revisions in FMPs
- Field compliance

Projects and Data Entry

- Project: Katmai Fuels Treatment monitoring at Brooks Camp
- Project: Terrestrial Lidar Scan plots in Denali
- Project: McCarthy University Subdivision 10-year remeasurement in Wrangell-St. Elias
- Data Entry: 2022 Field plots
- Data Entry: Complete QC of all FFI databases and posting

Reports/Outreach

- Report: WRST & DENA Fuels Treatment (Fire Effects Report)
- Report: ARCN 10-year trends
- Outreach: Denali teacher program
- Outreach: Success Stories/High Latitude Highlights

H. Overall Data Entry Status and FFI Suggestions

Data Entry Status

All data from the 2021 field season, except for the YUCH Sam Creek Hazardous Fuel Treatment plots, have been entered in the FFI remote app. Two new projects were also created for the YUCH Andrew Creek Aerial Vegetation/Burn Severity Survey project and the DENA FY21 Fuel Treatment Effectiveness project. Sam Creek data entry will be completed in 2022. Legacy data entry errors continued to be identified and corrected in both the “FFI_AKRO” and “FFI_AKWEST” databases. Additional fixes have been identified for 2022.

Table 12 estimates the number of fire ecology/fuels plots and projects since the mid-1980s that have been entered into FFI or another database format for the Interior Region 11 (Alaska) parks. Most data currently not included in FFI are the 2000-2003 era CBI plots. Other remaining non-FFI datasets are from fire effects projects that were implemented prior to 2005. It is desirable to convert some of the Access database projects into FFI, particularly the CBI plots (partially completed as of 2021).

Table 12. Number of known fire ecology or fuels plots and number of projects from the NPS Interior Region 11 (Alaska) by database type.

Database Type	Number of Plots	Number of Projects	% Plots	% of Projects
Access	335	6	22%	21%
Excel	15	1	1%	3%
FFI	1194	22	77%	76%
Totals	1544	29		

FFI Suggestions

There are several suggestions to improve the user interface and functionality of FFI, including:

- Add additional fields to the Reports (e.g., project name, sample date, year, and UV fields).
- Include the Project Unit Name in all queries that include multiple projects and in the Macroplot Report.
- Only include protocols with data when using the query function (instead of a list of all existing protocols).
- More detailed user guide instructions on all “Reports and Analysis” and “Toolbox” functions (including how density and other parameters are calculated using protocol heading fields).
- Ability to copy protocol UV field descriptions from one macroplot to another (within the same project unit) or set default UV field descriptions for each protocol.

References

Barnes, J. L., McMillan, J. and J. L. Hrobak. 2020. NPS Alaska Fire and Fuels Circular Plot Monitoring Protocol, Version 1.0. Alaska Fire Management – Fire Ecology Program. National Park Service, Fairbanks, Alaska. Available online at <https://irma.nps.gov/DataStore/Reference/Profile/2272265>

Appendix A. Reports, Publications, or Presentations Completed in 2021

- Barnes, J.L. 2021. 3D Assessment of fuels treatments: Terrestrial Lidar Scans as a new way to measure an old plot. NPS AKR High Latitude Highlights Article. Fall 2021
- Barnes, J.L. 2021. Denali Active Forest Management Program Brief. Fall 2021
- Barnes, J.L. 2021. Fire in Ecosystems: Boreal Forest. NPS web article
<https://www.nps.gov/articles/000/fire-in-ecosystems-boreal-forest.htm>
- Barnes, J.L. 2021. Reducing fire risk – treating, burning, and monitoring fuels treatment in Denali and Wrangell-St. Elias headquarters. Alaska NPS Web article:
<https://www.nps.gov/articles/000/reducing-fire-risk-treating-burning-and-monitoring-fuels-treatments-in-denali-and-wrangell-st-elias-headquarters.htm>
- Barnes, J.L. and Hrobak, J.L. 2021. [NPS Alaska Eastern Area FFI Fire Effects Monitoring Data](#). (FFI Dataset). National Park Service, Fairbanks, AK.
- Barnes, J.L. and Hrobak, J.L. 2021. [NPS Alaska Western Area FFI Fire Effects Monitoring Data](#). (FFI Dataset). National Park Service, Fairbanks, AK.
- Barnes, J.L. 2021. Fire Ecology & Fuels Monitoring Program. (Virtual Presentation). NPS Spring Seasonal Training. Fairbanks, AK. May 2021.
- Baltzer, J.L. et al. 2021. Increasing fire and the decline of fire adapted black spruce in the boreal forest. PNAS 2021 Vol. 118 No. 45. <https://doi.org/10.1073/pnas.2024872118>
- Holsinger, L. M., Parks, S.A., Saperstein, L.B., Loehman, R.A., Whitman, E., Barnes, J., and Parisien, M.A. 2021. Improved fire severity mapping in the North American boreal forest using a hybrid composite method. Remote Sensing in Ecology and Conservation. PP. 1-14.
<https://zslpublications.onlinelibrary.wiley.com/doi/10.1002/rse2.238>
- Hrobak, J.L. 2021. Alaska Field Logistics. (Virtual Presentation). NPS Spring Seasonal Training. Fairbanks, AK. May 2021.
- Hrobak, J.L. 2021. InReach Devices. (Virtual Presentation). NPS Spring Seasonal Training. Fairbanks, AK. May 2021.
- Hrobak, J.L. 2021. NPS Risk Assessments. (Virtual Presentation). NPS Spring Seasonal Training. Fairbanks, AK. May 2021.
- Hrobak, J.L. 2021. Virtual Risk Assessments. (Report, Unpublished). National Park Service. Fairbanks, Alaska.

- Hrobak, J.L. and Barnes, J.L. 2021. [Arctic Network Fire Extent and Frequency Resource Brief](#). Arctic Inventory and Monitoring Network, National Park Service. Fairbanks, AK.
- Hrobak, J.L. and Barnes, J.L. 2021. Fire Extent and Frequency Resource Brief for the Arctic Network. Web article: <https://www.nps.gov/articles/000/fire-extent-and-frequency-resource-brief-arctic-network.htm>
- Hrobak, J.L. and Humphrey, J. 2021. [InFORM Best Practices for Alaska](#). (Report, Unpublished). National Park Service and BLM-Alaska Fire Service. Fairbanks, AK.
- Larsen, A., Knapp, D., Barnes, J., Hults, C., Roland, C., Nicklen, E. 2021. After the Andrew Creek Fire. Yukon-Charley Rivers National Preserve Web Article <https://www.nps.gov/articles/000/andrewcreekpostfire.htm>
- Holsinger, L. M., Parks, S.A., Saperstein, L.B., Loehman, R.A., Whitman, E., Barnes, J., and Parisien, M.A. 2021. Improved fire severity mapping in the North American boreal forest using a hybrid composite method. Remote Sensing in Ecology and Conservation. PP. 1-14. <https://zslpublications.onlinelibrary.wiley.com/doi/10.1002/rse2.238>
- Sanders S., Mutch, L., Wasser, M., Barnes, J., and Perles, S. 2021. Rising From the Ashes: The Role of Fires in National Parks. Frontiers for Young Minds. 9:627635. <https://kids.frontiersin.org/articles/10.3389/frym.2021.627635>
- Smith, C.W; Panda, S.K; Bhatt, U.S; Meyer, F.J; Badola, A.; Hrobak, J.L. Assessing Wildfire Burn Severity and Its Relationship with Environmental Factors: A Case Study in Interior Alaska Boreal Forest. Remote Sensing. 2021, 13, 1966. <https://doi.org/10.3390/rs13101966>