

National Park Service

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Fire and Aviation Management



Appalachian/Piedmont/Coastal Fire Management Zone: Fire Ecology Annual Report, 2021





***Calopogon tuberosus* (grass pink orchid) growing in the Savanna burn unit at Moore's Creek National Battlefield. This botanically diverse site has been burned annually since 2016.**

On the Cover: The longleaf pine (*Pinus palustris*) woodland at Congaree National Park has been a focal point for prescribed burning by the National Park Service for over 22 years. The April 2021 prescribed burn was a great success, and long-term objectives for longleaf regeneration and herb diversity are being met on this site.

Appalachian/Piedmont/Coastal Fire Management Zone: Fire Ecology Annual Report, 2021

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Introduction

During 2021, fire-effects travel and monitoring largely returned to normal, despite the lingering global pandemic. A total of 64 plots were monitored at six different parks (**Table 1**), in addition to other field-based fire ecology support requested by park managers. There are five additional parks in our monitoring network that have plots but had no monitoring scheduled for 2021. As an effort to reduce the size of Table 1, plot totals for those parks that had no monitoring in 2021 were placed in a separate table (**Table 2**). Overall to date, the Appalachian/Piedmont/Coastal (APC) fire effects monitoring program has collected data for 577 plots in eleven different NPS units, and maintains a total of 236 permanent monitoring plots.

Monitoring highlights from the year included rapid-assessment monitoring with Survey123 at Moores Creek, Congaree, and Kings Mountain. This approach complements existing long-term FMH monitoring and burn-severity mapping to create a three-pronged monitoring design that yields important programmatic data as well as project-level assessments. Information from this approach is featured in each park's section of this report. Another major highlight of the year was our continued collaborative monitoring with the Southeast Coast Inventory and Monitoring Network at Congaree NP, Chattahoochee River NRA, and Kennesaw Mountain NB.

Implementation of fuels-management projects also returned to normal in 2021. A total of 16 projects were completed within our monitoring network for a total of 1741 acres treated (**Table 3**). Members of our team participated directly in implementation and/or monitoring of 75% of these projects, playing key roles in each of the larger prescribed burns (**Figure 1**).



Figure 1. APC Zone Fire Ecology Team with overhead at ‘RCW’ Rx Burn at Congaree NP. **From left:** Travis Nepl, *Matt Wood, Wylie Paxton, Alex Scronce, Chris Revels, and Rob Klein.* Team members italicized.

Additional accomplishments of the fire ecology program included: support for Fire Management Plan updates, leading field tips and professional presentations, support for Resource Advising (READ) on western wildfires, fire and fuels project mapping (GIS), maintenance and support for RAWS, and updating parks to NFDRS2016 (**Table 4**).

Table 1. APC Zone Fire Effects Plot Workload (2021) and Total Plots Installed

Park	Monitoring Unit	Plot Type (FMH Forest/Brush/Grass plot, photo point, Rapid Assessment, CBI, etc.)	Pre-burn 2021	Immed. Post 2021	Post-burn (1-20 yrs) 2021	Annual Total (2021)	Total Plots
Big South Fork (BISO)	Little Bluestem	FMH Forest Plot			2	2	4
	Shortleaf Pine	FMH Forest Plot				0	2
	White Oak	FMH Forest Plot				0	13
	LFEM	FIREMON				0	21
	CBI	CBI				0	9
	Fuels Trans	Fuels Transect				0	4
Congaree (CONG)	Loblolly Pine	FMH Forest Plot		3		3	5
	Longleaf Pine	FMH Forest Plot		5		5	5
	Harry Hampton Mastication (LFEM)	FIREMON				0	17
	Rapid Assessment	Survey123			11	11	11
Fort Raleigh (FORA)	Photo Point	Photo Point			3	3	3
	Rapid Assessment	Survey123			3	3	3
Great Smoky Mountains (GRSM)	Black Oak	FMH Forest Plot				0	8
	Scarlet Oak	FMH Forest Plot		2	4	6	15
	Yellow Pine	FMH Forest Plot				0	40
	LFEM	FIREMON			2	2	49
	Mech Trt	Photo Points				0	18
	CBI	CBI				0	128
	Fuels Trans	Fuel Transect				0	18
	Rapid Assessment	Survey123			12	12	23
Kings Mountain (KIMO)	Blackjack Oak	FMH Forest Plot				0	8
	Chestnut Oak	FMH Forest Plot		3	3	6	21
	LFEM	FIREMON					20
	Fuels Trans	Fuel Transect				0	3
	Rapid Assessment	Survey123			3	3	3
Moore's Creek (MOCR)	Photo Points	Photo Points			2	2	2
	Rapid Assessment	Survey123			6	6	6
Total			0	13	51	64	459

Table 2. APC Zone Fire Effects Plots - Not Read During 2021

Park	Monitoring Unit	Plot Type (FMH Forest/Brush/Grass plot, photo point, Rapid Assessment, CBI, etc.)	Pre-burn 2021	Immed. Post 2021	Post-burn (1-20 yrs) 2021	Annual Total (2021)	Total Plots
Blue Ridge Parkway (BLRI)	Chestnut Oak	FMH Forest plot				0	2
	LFEM	FIREMON				0	7
	Fuels Transect	Fuel Transect				0	6
	Photo Points	Photo Point				0	6
Cape Hatteras (CAHA)	LFEM	FIREMON				0	17
	Photo Points	Photo Point				0	33
	Photo Points (Non-Permanent)	Photo Point				0	10
Chickamauga & Chattanooga (CHCH)	LFEM – Post Oak Woodland	FIREMON				0	3
	LFEM - Glade	FIREMON				0	6
Cowpens (COWP)	Southern Red Oak	FMH Forest plot				0	2
Cumberland Gap (CUGA)	Scarlet Oak	FMH Forest plot				0	16
	LFEM	FIREMON				0	10
Total						0	118

Table 3. Summary of 2021 Fuels Treatments and Associated Monitoring

Park	Treatment Name	FMH Plot ?	Other Monitoring	Acres
Big South Fork (BISO)	Burke Fields	No	No	40
Cape Hatteras (CAHA)	South Nags Head Mech Trt	No	Mapping Only	90
	Ocracoke Mech Trt	No	Mapping Only	10
Chickamauga & Chattanooga (CHCH)	Upper Truck	No	Mapping Only	60
Congaree (CONG)	Harry Hampton VC Rx	Yes	Yes (FEMO & Survey123)	175
	RCW Rx	Yes	Yes (FEMO & Survey123)	320
Fort Raleigh (FORA)	Heritage Point Mech Trt	No	Yes (Photopoints and Survey123)	10
Great Smoky Mountains (GRSM)	Wear Cove Gap Rx	Yes	Yes (FEMO & Survey123)	180
	Primitive Baptist Rx	No	Yes (FEMO & Survey123)	338
	Cades Cove Mech Trt	No	Yes (Qualitative and Mapping)	159
Kings Mountain (KIMO)	Battlefield Rx	Yes	Yes (FEMO & Survey123)	200
	Partner Rx (small)	No	Yes (Qualitative)	28
	Mechanical (powerline, Midway)	No	Yes (qualitative)	100
Moore's Creek (MOCR)	Savannah Rx	No	Yes (Photopoints and Survey123)	12
	North East Rx	No	Yes (Survey123)	9
Wright Brothers (WRBR)	West WUI Mech Trt	No	Yes (Qualitative)	10
	16	4	12	1741

Table 4. Fire Ecology Staffing 2021

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	READ Qualified (Yes or No)	Training and Development
Rob Klein (Fire Ecologist)	1/1/21	12/31/21	26	Yes	APC RX burns; Panel member on Climate/Fire webinar; NPS Fire/Climate Workgroup; Assisted SECN I&M at CHAT; FMP updates for several Zone parks; Presented at 9 th AFE Fire Congress.
Wylie Paxton (Lead Monitor)	1/1/21	12/31/21	26	Yes	READ on Dixie & Mcfarland WFs; FEMO & ENGB(t) on APC Zone RX burns; Detail with SECN I&M; InFORM Inspector Training; Fire GIS Webinar Series; Attended 9 th AFE Fire Congress.
Matt Wood (Assistant Lead)	1/1/21	12/31/121	26	No	FEMO on APC RX burns; Assisted SECN I&M crew at CHAT; NC FDOP Workshop; 9 th AFE Fire Congress; Led field trip for SIU Forestry Class; Developed Survey123 Rapid Assessment Form; WIMS maintenance for GRSM and CAHA.

Big South Fork National River and Recreation Area (BISO): 2021 Fire Effects Monitoring Annual Report

Activity Summary

During 2021, the APC Zone Fire Ecology team continued to provide fire ecology and fire effects monitoring services to BISO, although fire planning and operations services are now provided by the Mississippi River Fire Management Zone. BISO completed a single prescribed burn in 2021 for 40 acres at Burke Fields. There are no long-term monitoring plots at Burke Fields, and no fire effects monitoring was completed for the project.

The APC Zone team made a trip to BISO in August to conduct long-term monitoring at the Newtie King site. Prescribed burning of Newtie King had been prioritized for 2021, but this burn was not completed. A detailed report concerning the long-term trends at Newtie King was included in the 2019 Annual Report.

The focus for our program in the coming year will be to provide operational and monitoring support for any prescribed burns or non-fire fuels-management projects at BISO. The other priority will be to complete the summer monitoring for any plots that burn during the 2022 burn season. There is one burn currently listed in the BISO multi-year fuels treatment plan for FY22, which is Divide Road. Darrow Ridge and Newtie King were planned for FY21, and these units may also be carried over for 2022. Each of these units contains long-term monitoring plots.

Long-Term Monitoring Results

No long-term monitoring plots were burned in 2021, and no data were collected to provide updates to the monitoring results table. For reference, the long-term monitoring results table from last year's annual report is provided below (**Table 5**). The accompanying text from last year's report provided a good overview of the data trends from the BISO prescribed burn program, and that overview is worth repeating. That text is included below:

An important take away from all of these long-term results is that *prescribed-fire restoration takes time and a commitment to frequent burning*. Until all of the plots have been burned multiple times, and the data can be collected and analyzed, we must rely on these trends to determine if the program is heading in the right direction. Findings up to this point indicate that most of the trends for the objective-related variables are favorable, *with the exception of fuel loading and perhaps pole-sized tree reduction*. These data point to valuable lessons that we have learned, and that have been discussed in detail in previous annual reports. To sum:

- Total-fuel-load changes during prescribed fire restoration do not appear to be uni-directional, and total fuel loads may actually *increase* as mature trees are killed by fire and other events
- Large canopy gaps created during initial burning can lead to rapid growth of resprouting red maple and other undesirable species, greatly complicating restoration efforts.

Table 5. Management Objectives and Monitoring Results

All results shown are 80% confidence intervals of the mean. Fuel reduction objectives/results are mean percent reduction from pre-burn to immediate post-burn. An underlined number of plots indicates that the minimum sample size has been attained for that variable.

Vegetation Type	Management Objective Restoration Phase- (After 4 burns)	Monitoring Results (80% confidence intervals)	Progress Towards Meeting Objectives	Year Last Analysis Completed
Dry Oak Forest (FQUAL1)	>50% Reduction in total fuel loading	<u>Total fuel load change</u> After one burn (n= <u>10</u>): -52% ($\pm 3\%$) After 2 burns (n=8): -43% ($\pm 7\%$) After 3 burns (n=3): 46% ($\pm 27\%$)	More data needed. Objective may need to be reevaluated.	2018
14 plots - <i>11 have burned once</i>	>70% Reduction in pole-sized tree density ($\leq 15\text{cm dbh}$)	<u>Pole reduction</u> After one burn (n= <u>10</u>): 62% ($\pm 11\%$) After 2 burns (n=4): 93% ($\pm 10\%$) After 3 burns (n=2): 69% ($\pm 27\%$)	Trend is very positive. More burns and data needed.	2018
<i>7 have burned twice (3 Fuel Transects have also burned twice)</i>	20-40% Reduction in overstory tree density ($>15\text{cm dbh}$)	<u>Overstory reduction</u> After one burn (n= <u>11</u>): 5% ($\pm 3\%$) After 2 burns (n=5): 36% ($\pm 17\%$) After 3 burns (n=3): 28% ($\pm 40\%$)	Trend is very positive. More burns and data needed.	2018
<i>5 have burned three times</i>	>200 tall ($>1\text{m}$) Oak seedlings /ac	<u>Oak Seedlings:</u> Preburn (n=11): 199/acre (± 162) After 1 burn (n=11): 537/acre (± 276) After 2 burns (n=5): 1020 (± 545) After 3 burns (n=3): 1161 (± 334)	Trend is very positive. More burns and data needed.	2018
<i>3 remain unburned</i>	>30% Cover by native herbs	Preburn: 10.5% (± 6.9) After 1 burn: 10.2% (± 4.7) After 2 burns: 27.6% (± 16.6) After 3 burns: 37.5% (± 10.4)	Trend is very positive. More burns and data needed.	2021
Little Bluestem Sandstone Glade (FSCSC1)	>70% Reduction in pole-sized tree density	<u>Pole reduction:</u> After 1 burn (n=3) = 14% ($\pm 16\%$) After 2 burns (n=3) = 29% ($\pm 23\%$) After 3 burns (n=3) = 34% ($\pm 23\%$) After 4 burns (n=2) = 35% ($\pm 20\%$)	Insufficient data, but the trend is very positive. Objective may need to be revised.	2018
3 plots- <i>2 have burned five times</i> <i>1 has burned three times</i>	>100% Cover by native herbs	Preburn cover: 98% (± 26) After 1 burn (n= 3): 123% (± 28) After 2 burns (n= 3): 133% (± 30) After 3 burns (n= 3): 102% (± 32) After 4 burns (n= 2): 138% (± 71)	Insufficient data.	2019

Blue Ridge Parkway (BLRI): 2021 Fire Effects Monitoring Annual Report

Activity Summary

BLRI did not complete any prescribed burning or non-fire fuels-management projects in 2021, and hence no long-term monitoring was completed. The Hyatt Cove Wildfire occurred jointly on BLRI and Cherokee BIA on November 10, 2021. Approximately 114 acres of BLRI was burned in this event. The APC Zone Fire Ecology team conducted initial monitoring and rehab during 2021, including creation of an Initial Burn Severity map for the site (**Figure 2**).

The focus for our program in the coming year will be to provide operational and monitoring support for any prescribed burns or non-fire fuels-management projects at BLRI, as needed. At least two interagency prescribed burns are planned with the US Forest Service: Lost Bear and Singecat. Though there are no long-term monitoring plots on the NPS portions of these burns, some qualitative monitoring may be done on these sites if they are completed. The other priority will be to complete growing-season monitoring of the Hyatt Cove wildfire site in order to document basic fire effects.

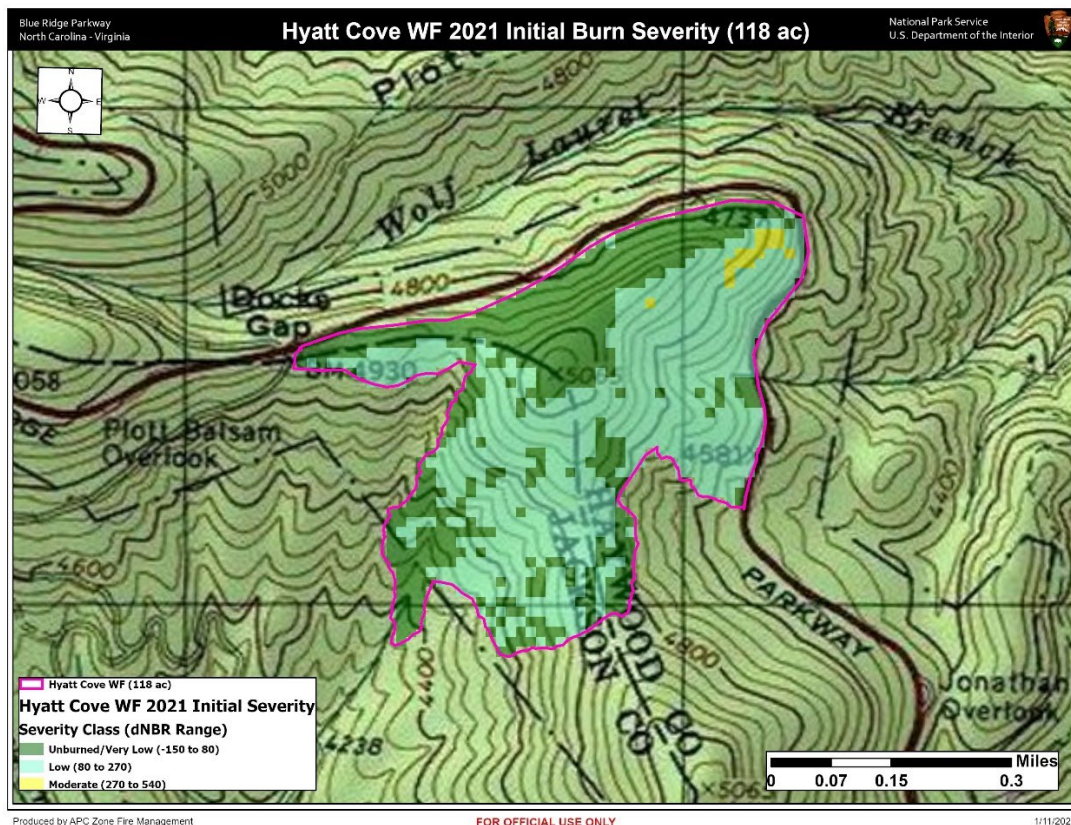


Figure 2. Map of Hyatt Cove Wildfire showing Initial Burn Severity. The legend provides severity levels.

Chickamauga and Chattanooga National Military Park (CHCH): 2021 Fire Effects Monitoring Annual Report

Activity Summary

CHCH did not complete any prescribed burning in 2021, and hence no long-term monitoring was completed. A small non-fire fuels-management project was completed on the Upper Truck Trail of the Lookout Mountain unit, but there was no monitoring associated with this project. The APC Fire Ecology program provided planning support for CHCH during 2021, assisting with the update of the Fire Management Plan and movement of the FMP into the 2021 NPS Framework.

The focus for our program in the coming year will be to provide operational and monitoring support for any prescribed burns or non-fire fuels-management projects at CHCH, as needed. The multi-year fuels treatment plan includes the 'Viniard-Alexander Central' prescribed burn project for FY22. This unit contains 9 long term monitoring plots, and these will be monitored in 2022 if the prescribed burn is completed. The goals and objectives for the Viniard-Alexander prescribed burns, along with a map of the 'Viniard-Alexander Central', are provided below for reference.

Goals and Short-Term Objectives for Glades and Oak/Pine Woodlands at CHCH:

A. Glades

Long-term goal: Maintain or expand current areal extent and species composition of herb-dominated glades by reducing woody stem density and limiting future woody encroachment.

- a. Burn at least 90% of herb-dominated glade area
- b. Consume at least 80% of fine fuels over the burned area
- c. Top-kill >40% of small woody stems (less than 2.5" dbh) within the glade perimeter

B. Oak/Pine Woodlands

Long-term goal: Restore an oak/shortleaf pine/(loblolly pine?) woodland characterized by an open canopy and midstory, adequate oak and shortleaf pine regeneration, and >30% cover of native herbaceous species.

- a. Burn at least 70% of area currently dominated by oak, loblolly pine, or shortleaf pine
- b. Consume at least 80% of fine fuels over the burned area
- c. Top-kill >30% of small woody stems (less than 4" dbh) within oak and oak-pine forest

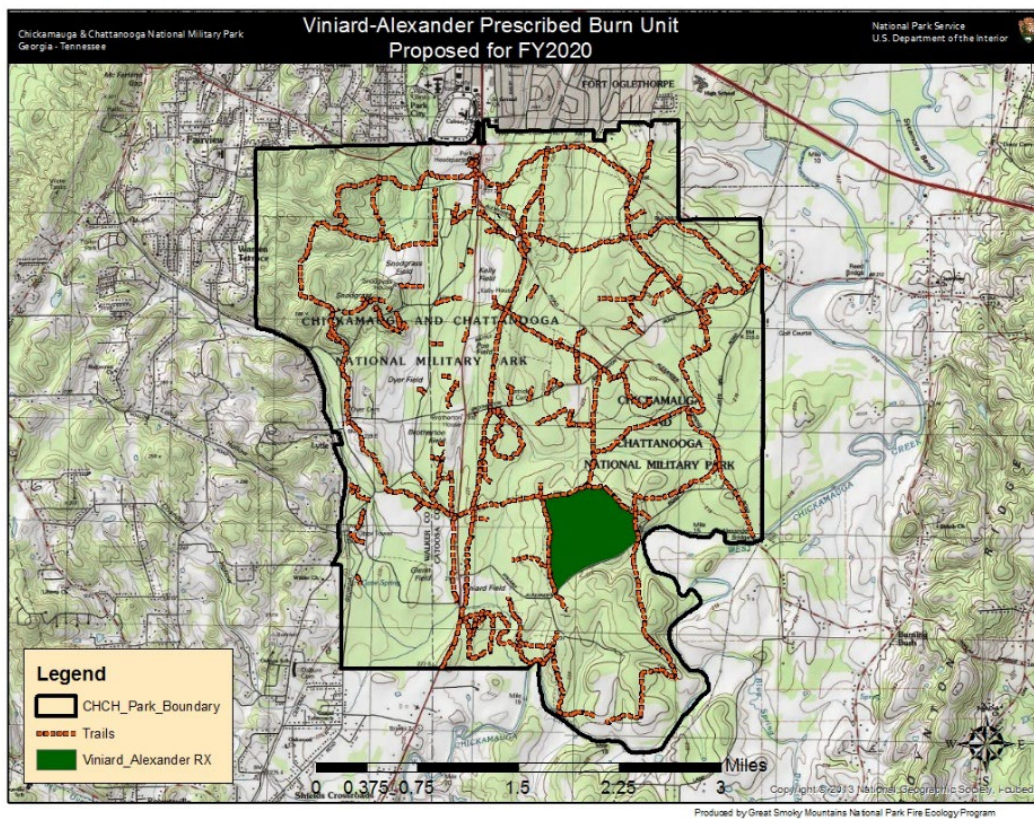


Figure 3. Location of proposed ‘Viniard-Alexander Central’ prescribed burn unit.

Congaree National Park (CONG): 2021 Fire Effects Monitoring Annual Report

Activity Summary

During 2021, the APC Zone Fire Ecology team made three trips to provide operational, planning and monitoring support for the CONG fire program. CONG completed two large prescribed burns in 2021: Harry Hampton East and RCW. Our team supported both of these burns as Fire Effects Monitors (FEMO) and igniters, and also completed all immediate postburn monitoring.

An additional trip was made in June to complete growing-season monitoring of long-term plots in the Harry Hampton and RCW burn units. Additional rapid assessment monitoring was also completed in the two burn units, and the crew evaluated the Griffins Creek burn unit at the Park's request. These burns and monitoring are described in the "Review of 2021 Projects" section of this report.

The focus for our program in the coming year will be to provide operational and monitoring support for any prescribed burns or non-fire fuels-management projects at CONG. The other priority will be to complete the growing-season monitoring for any plots that burn during the 2022 burn season. The CONG multi-year fuels treatment plan for FY22 currently lists burns of Red Bluff Road and Dawson's Cabin, along with follow up burns of RCW and Harry Hampton.

Review of 2021 Projects

Harry Hampton East Prescribed Burn

On March 11, 2021 the Harry Hampton East unit was burned for ninth time since 2002. A mechanical treatment occurred in this unit in 2016-2017 along with other treatments of herbicide and a small number of longleaf pines have been planted in successive years. The Harry Hampton East unit is located on the east side of Main Park drive and the park boundary (see map below). The location is in one of the few higher quality upland pine communities in the park.

The Park's overall goals for burning in the pine-dominated uplands are to reduce hazardous fuel loading along the park boundary and restore a grassy pine woodland. To achieve these goals, the Park attempts to burn these upland units on a two-year rotation.

The fuels carrying the fire were a combination of tall warm season grasses, pine litter with short grass, pine litter, and compact hardwood litter. Observed vegetation changes in the unit from 2000 to 2021 have been significant in terms of fuel type and composition, and the unit has increasingly become dominated by the combination of grass and pine litter fuels. **Figures 4 & 5** below represent this change in fuels and stand "openness" in the Harry Hampton unit after 17 years and 8 prescribed burns. The area depicted in Figures 4 & 5 was not included in the mastication work of 2016.



Figure 4. Long term monitoring Pre-Photo of PITA10.



Figure 5. Long term monitoring - 8 burns and seventeen years later.

Weather predictions and observed weather for burn day were closely aligned and provided for successful burning conditions. Fire behavior observed on burn day corresponded to fuel type and firing pattern. Common observations were backing fire through short stature grass and pine litter and backing/flanking fire with occasional head fire through tall warm season grasses (**Figure 4**).

The high-quality warm season native grass area on the north end of the unit is dominated by several species of *Andropogon* (Broom Sedge), *Erianthus* (plume grass) and scattered populations of *Sorghastum nutans* (Indian grass). This area burned extremely well with a range

of fire behavior. **Figure 4** illustrates typical fire behavior observed in this area. This approximate 1–2-acre patch of high-quality warm season native grasses is unique, and it should be monitored in future years as the burn program continues.



Figure 6. Backing fire behavior in warm season grass area

Overall, the successful firing pattern and complete coverage of the burn resulted in meeting the objective for top kill on small hardwood stems (predominantly sweetgum) (**Figure 7**).

Specific objectives were as follows:

1. Reduce 1-hr fuels 50-80% over 75% of the unit, as measured post-burn.
2. Reduce the density of pole-sized trees (1-6"dbh) by 20-70% as measured 1-year post burn.
3. Overstory mortality (small-scale) up to 30% as measured 1-year post burn.

Observations from burn day and subsequent monitoring conducted over the summer indicate that these objectives were very likely met. Due to the frequency of burning in this unit, only limited data were collected from the four long term monitoring plots. Instead, the monitoring team conducted Rapid Assessment monitoring using a form created in Survey123. This method allowed us to range widely through the 2021 burn units, collecting data and photos from areas outside our monitoring plots. The data are accessed in ArcGIS Online, and provide a great complement to our burn severity mapping and long-term plot monitoring.



Figure 7. This photo from Survey123 Rapid Assessment Monitoring was taken on June 11, 2021 during the first growing season following the burn. The image illustrates that the burn met objectives by top-killing nearly all pole-sized sweetgum. Native grasses and sweetgum sprouts compete for space in the understory. Vegetation and fuels data associated with this point can be viewed in ArcGIS online.

The area coverage provided by the Survey123 Rapid Assessment monitoring also allows greater opportunities to observe fire effects in different vegetation types, outbreaks of invasive plants, and uncommon plant species. One such observation of a higher-quality herb (*Liatris* spp. = blazing star) is documented in the photo below. Other qualitative observations from the photo below are the lack of 1000 hour fuels and limit of poles in the field of view.



Figure 8. Blazing star species found 09yr01.

RCW Prescribed Burn

The 2021 RCW prescribed burn treatment was completed on 4/6/21. The burn unit has been treated 11 times at the current perimeter, although smaller burn treatments occurred prior to 1999 within the core longleaf pine area. This core area represents the best example of longleaf pine wet savanna located in the park, containing an open overstory with little to no midstory and a diverse herbaceous understory with significant grass fuels. The unit is 306 acres located east of Caroline Simms Road and approximately 12 acre of private land jutting north of the otherwise straight park boundary line for a total of approximately 320 acres. The private section is included as an agreement with a local hunt club and is positioned below their wildlife pond for easy access with UTV's to the whole unit and has typically been included when feasible. The private land was clear cut following the historic flood event of 2015 and is a mix of successional hardwoods, loblolly pine and successional herbs and grasses. The unit is directly east of all park structures and contains a small walk-in campground that is excluded from burning.



Figure 9. Fire behavior in open stands

Fire burned with a range of intensities and effects throughout the day. Initially, progress was slow but steady in the compacted and shaded pine litter on the east side of the unit creating only light scorch on vegetation. However, as humidity dropped and ignitors moved west into the core longleaf pine area with open grass and waxy low-shrub fuels, intensity markedly increased resulting in scorch reaching into the overstory in spots (**Figure 9**). Fire carried well off the north line and readily moved to the bluff edge and down to the floodplain along the south side of the unit. Fire intensity was moderate through plantation-like pine fuels west of the longleaf area and south of the private property where Dry Branch flows south through the unit. While initially patchy and slow in the scrubby open grass and blackberry fuels of the private section, the

intensity increased and the area burned almost completely. The western section of the burn along the Caroline Simms Road contained a large pre-existing canopy gap with heavy fuel loading located relatively close to the small walk-in campground. Ignition was slowed in this area to burn around the campground in order to exclude it, and fire was carefully worked through the canopy gap area to reduce intensity and to help retain the remaining overstory along the fringe of the gap. Firing was completed in the southwest corner of the unit along the edge of the floodplain boardwalk.

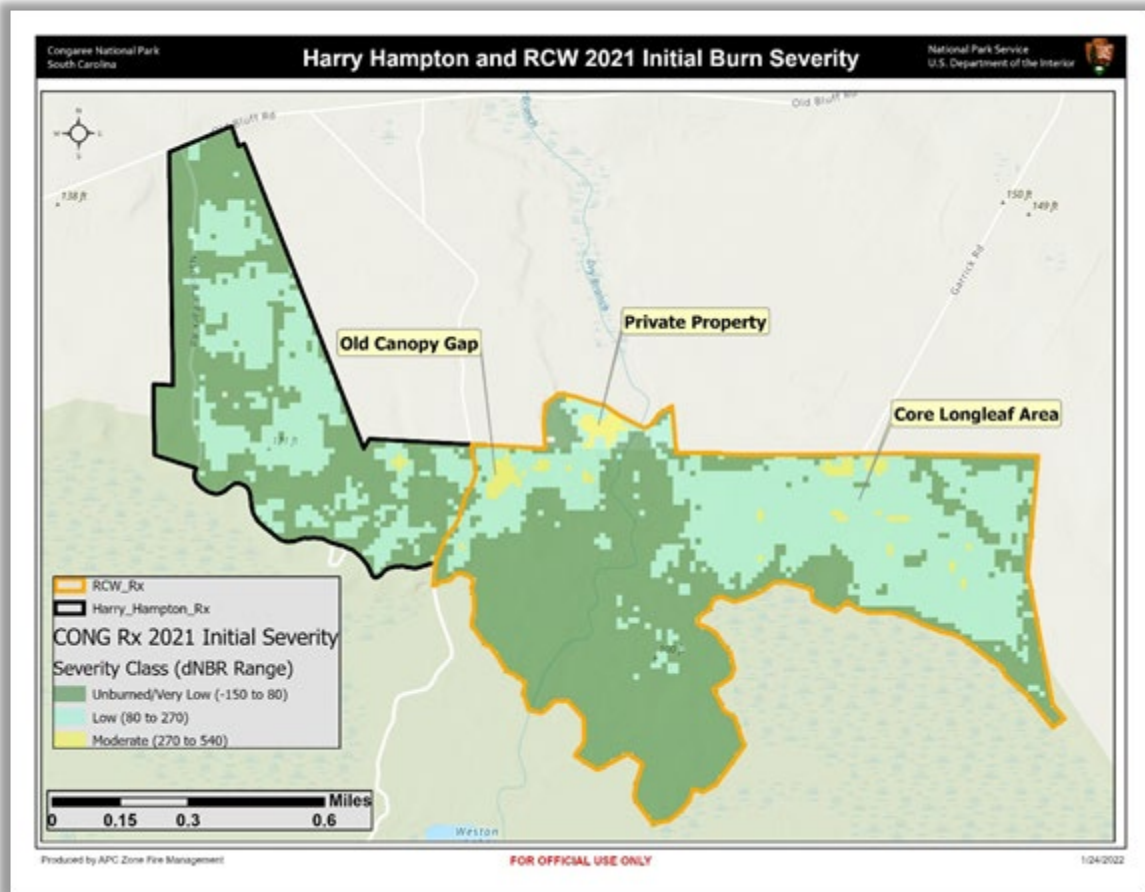


Figure 10. Initial burn severity of 2021 RCW and Harry Hampton Rx Burns

An initial burn severity map was created for the 2021 RCW and Harry Hampton burns (**Figure 10**), which effectively highlights the areas of higher scorch in pine dominated forests and areas with sparse canopy where understory effects are more pronounced. The RCW area (outlined in orange on the map) clearly shows the scattered areas of higher intensity (blocks of yellow moderate severity) in the core longleaf area where scorch occasionally reached the upper canopy (**Figure 11**). Additional areas showing moderate severity included both the private property and the old canopy gap, where the lack of overstory causes the severity map to highlight the effects in the understory. The area of very-low severity south of the private property section encompasses the Dry Branch drainage and a low spur of planted loblolly pine that juts into the floodplain.



Figure 11. Example of high scorch in core longleaf area

Scouting during the growing season showed that, despite the high scorch, very little mortality was observed in the overstory or understory longleaf, with scorched trees simply growing new needles. The frequent early growing-season burning appears to continue to favor the herbaceous understory, particularly the expansion of grasses in both the core longleaf as well as throughout the burn unit, which is an ongoing process that has been observed over the last few burns (**Figure 12**).



Figure 12. Open post oak stand along the northern edge of the unit. This area also illustrates the expansion of native herbs, grasses, and sedges in the understory throughout RCW.

Near the core longleaf area were small, scattered patches of post oak (*Quercus stellata*) along the north edge of the unit that have survived the repeated burns. Although still crowded by encroaching loblolly pine, they are starting to become more open and recognizable stands (**Figure 12**). Also of note, along the north boundary, just west of the core longleaf area, trial herbicide treatments were used in conjunction with fire to treat understory sweetgum stems which typically resprout vigorously following burns, competing with more desirable herbaceous species. Areas where the stems were treated showed almost no resprouting of sweetgum versus adjacent untreated areas (**Figure 13**).



Figure 13. Sprayed and burned sweetgum saplings. Note the lack of resprouting at the base of each stem, and contrast this with the rapid resprouting of sweetgum that was burned but *not* sprayed.

Overall, this was an excellent burn treatment for the RCW unit, clearly meeting outlined objectives, with high coverage and good consumption of litter and 1-hr and 10-hr fuels. Additionally, understory sweetgum resprouts were generally top-killed and some additional thinning of mid- and overstory encroaching loblolly pine was observed. Retention of overstory longleaf pine and use of firing techniques that avoided large canopy gap formation were also achieved.

Key Observations:

1. Frequent (2yr return interval) burning has been effective at keeping understory sweetgum in check
2. The repeated use of early growing season burns appears to continue to favor herbaceous species in the understory, particularly grasses

3. Longleaf pine of all sizes showed good survivorship despite heavy scorch, although care should still be used with firing technique to avoid large canopy gap creation in the core area
4. Patches of post oak along the north line appears to be favored by repeated burns, becoming more open and recognizable stands.
5. Herbicide treatment of sweetgum resprouts in conjunction with burning appeared to be very effective and could be a useful management tool moving forward.

Griffins Creek Burn Unit Evaluation

At the request of CONG staff, the fire ecology team conducted a reconnaissance and ecological evaluation of the Griffins Creek Burn Units. This unit burned once in the past (2008?), and the Park is considering bringing it back into the prescribed burn rotation.

Georeferenced maps were created for Avenza to navigate in the area and record basic vegetation and fuels observations. To highlight potential areas of interest for scouting, maps of current vegetation and historic vegetation (created by Cecil Frost) were used. The team spent half of a day conducting the assessment, and were able to access and see significant portions of the unit via the train right-of-way that forms the eastern boundary of the unit.

The following brief assessment was sent to park managers following the site visit in June 2021:

The site is dominated by relatively young, planted loblolly pine and an older, more natural stand on the southern end. We saw very few signs of the 2008 prescribed burn. The ecological quality is low-moderate. The understory is dominated by vines and sweet-gum, with very little grass or herbs. The restoration potential of this site is most comparable to the Red-Bluff Road burn units, and meaningful ecological restoration would require a sustained long-term commitment.



Figure 14. 'Typical' loblolly pine forest observed in Griffins Creek burn site.

Long-Term Monitoring Results

There are no updates to the long-term monitoring results for this year's annual report. The results table from last year's report are provided for reference.

Table 6. *Objectives and long-term monitoring results for CONG*

* There are numerous longleaf seedlings within the core longleaf area and some additional seedlings near the Bluff Campground.

Vegetation Type	Management Objective Restoration Phase- After ?? burns	Monitoring Results	Progress Towards Meeting Objectives	Year Last Analysis Completed
Longleaf/ Loblolly Pine Woodland (FPIPA1) 5 plots	>50% Reduction in total fuel loading	Fuel reduction - 7 burns: 10% (n=4 plots, 1 burn unit)	No. The objective needs to be changed	2019
	15-30% Reduction in overstory tree density	Overstory reduction - 10 burns: 16% (n=4 plots, 1 burn unit)	Yes	2019
	>200 tall (>1m) Longleaf pine seedlings /ac	Preburn density: data not clean After 8 burns: 4/acre (n=4 plots, 1 burn unit)	No*	2019
Loblolly Pine Forest (FPITA1) 5 plots	>50% Reduction in total fuel loading	Total fuel reduction - 5 burns: 20% (n=3 plots, 1 burn unit)	No. The objective needs to be changed	2019
	>70% Reduction in pole-sized tree density	Pole reduction – 8 burns: 87% (n=3 plots, 1 burn unit)	Yes	2019
	25-50% Reduction in overstory tree density	Overstory reduction – 8 burns: 28% (n=3 plots, 1 burn unit)	Yes	2019

Cumberland Gap National Historical Park (CUGA): 2021 Fire Effects Monitoring Annual Report

Activity Summary

During 2021, the APC Zone Fire Ecology team continued to provide fire ecology and fire effects monitoring services to CUGA, although fire planning and operations services are now provided by the Mississippi River Fire Management Zone. No prescribed burning or fuels management projects were completed in 2021, and hence no long-term monitoring was completed.

The focus for our program in the coming year will be to provide operational and monitoring support for any prescribed burns or non-fire fuels-management projects at CUGA. The other priority will be to complete the summer monitoring for any plots that burn during the 2022 burn season. There are two burns currently listed in NFPORS for Cumberland Gap: Tiprell and Lewis Hollow. Both of these units contain long-term monitoring plots.

Long-Term Monitoring Results

No updates have been made to the long-term results table for CUGA. Past table provided for reference.

Table 7. *Results of long-term fire effects monitoring at Cumberland Gap NHP.*

Vegetation Type	Management Objective Restoration Phase- (After 4 burns)	Monitoring Results (80% confidence intervals)	Progress Towards Meeting Objectives	Year Last Analysis Completed
Dry Oak Forest (FQUCO1) <i>16 plots</i>	>50% Reduction in total fuel loading	<u>Total Fuel Reduction:</u> After 1 burn (n= <u>16</u>): 29% (± 3) After 2 burns (n= <u>11</u>): 26% (± 2)	Trend is favorable. More data needed.	2013
	>70% Reduction in pole-sized tree density ($\leq 15\text{cm dbh}$)	<u>Pole Reduction:</u> After 1 burn (n= <u>16</u>): 39% (± 5) After 2 Burns (n= <u>11</u>): 67% (± 3)	Trend is very favorable. More data needed.	2013
	15-30% Reduction in overstory density ($>15\text{cm dbh}$)	<u>Overstory Tree Reduction:</u> After 1 burn (n= <u>16</u>): 5% (± 5) After 2 Burns (n= <u>11</u>): 8% (± 1)	Trend is very favorable. More data needed.	2013
	>200 tall ($>1\text{m}$) Oak seedlings /acre	Preburn (n=16 plots): 101/ac (± 12) After 1 burn(n=16): 91/acre (± 6)	Trend is very favorable. More data needed.	2011
	>30% Cover by native herbs	Preburn cover (n=14): 2% ($\pm 1\%$) After 1 burn (n=14): 4% ($\pm 2\%$)	Minimal change. More data needed.	2011
	< 20 Invasive exotic plants/acre	Preburn avg (n=16): 0/acre Post burn mean (n=16): 20/acre (± 14)	Unclear due to high variability.	2011

Note: An underlined sample size number indicates minimum plots exist for 80% Confidence Level.

Great Smoky Mountains National Park (GRSM): 2021 Fire Effects Monitoring Annual Report

Activity Summary

During 2021, the APC Zone Fire Ecology team supported GRSM with fire operations, fire planning, GIS, and fire effects monitoring. The team participated and provided leadership for the Primitive Baptist and Wear Cove Gap prescribed burns in the spring of 2021. Team members made substantial progress on the GRSM Fire Monitoring Plan during 2021, and hope to complete that plan during 2022. The Fire Ecologist led the APC Zone in updating the Fire Management Plan in 2021 and began the process of a more comprehensive update for 2022. The Lead Monitor and Assistant Lead provided substantial GIS support for the fire program, providing detailed maps for all fuels projects, submission of maps for all wildfires and completed fuels projects, and severity mapping for the Wear Cove Gap prescribed burn.

Highlights from 2021 fire effects monitoring included detailed monitoring of the Wear Cove Gap burn, monitoring of fuels projects in Cades Cove, and continued monitoring of the Chimney Tops 2 wildfire. While monitoring the Chimney Tops 2/Ski Mountain mechanical fuel reduction project, the team found 2 significant populations of the rare plant *Thermopsis* (Golden-banner) (Figure 15), and shared this find with the GRSM Inventory & Monitoring program.



Figure 15. *Thermopsis* spp. blooming along the Cove Mountain trail in the Chimney Tops 2 wildfire site.

Monitoring of Wear Cove Gap and Cades Cove are discussed further in the “Review of 2021 Projects” section of this report. The focus of our program in the coming year will be to provide operational and monitoring support for any prescribed burns or non-fire fuels-management projects at GRSM. The other priority will be to complete the summer monitoring for any plots that burn during the 2022 burn season. Finally, completing the Fire Effects Monitoring Plan will be a major priority in the coming year.

Review of 2021 Projects

Wear Cove Gap Prescribed Burn

The 2021 Wear Cove Gap prescribed burn (175 acres) was completed on 3/9/21. This marked the 2nd entry for this unit with a 12-year lapse between burns (the first occurred on 4/17/09). The unit is a wildland urban interface (WUI) burn in dry oak and yellow pine fuels along the GRSM park boundary on the ridgeline above the adjacent Wears Valley community. There are 5 homes directly bordering the north end of the unit along the boundary and a park hiking trail running east-west through the north portion of the burn just downslope of the houses and parallel to the boundary. Buildup of dry oak and pine litter under a flammable evergreen mountain laurel shrub layer as well as accumulation of heavies from mortality of yellow pine due to southern pine beetle (SPB) all contributed to the fuel concerns adjacent to the structures along the boundary. Additionally, the majority of the unit contains fire adapted oak and pine communities, including a rare barrens area on the south end containing numerous herbaceous species, allowing this burn to meet both fuels reduction and ecological goals.

The burn occurred during the end of a roughly 2 week dry period from 3/2/21 through 3/12/21. A high pressure system had set in over the region, resulting in conditions that appeared to be creating a subsidence inversion. Low relative humidity persisted through the daytime and often decreased overnight at mid to upper elevations. This condition worsened as the high pressure system persisted, with the driest conditions occurring both the day before and day of the burn. However, during the days following the burn and prior to rain returning on the evening of 3/12/21, cloud cover and some slight moisture did return to the area partially moderating the low humidity although overnight recovery remained poor.



Figure 16. Example of fire carrying well under yellow pine and mountain laurel fuels.

Overall, fire carried exceptionally well throughout the entire unit with low to moderate intensity (**Figure 16**). Generally, the leaf litter was completely consumed, and the upper duff layer was lightly to partially consumed. Immediate post burn FMH plot data showed 100% reduction in litter and 29% reduction in duff as compared to measurements taken just before the burn. Additionally, the ubiquitous, dense mountain laurel and rhododendron shrub layer along with other understory woody stems received significant basal wounding and nearly 100% scorch across most of the unit, resulting in significant top-kill (**Figure 17**).



Figure 17. Example of post burn shrub and understory tree mortality.



Figure 18. Typical post burn effects with low impact to the midstory and overstory trees.

The midstory saw some light thinning especially in areas where encroaching white pine received heavy scorch, while the overstory appeared to largely remain intact with average char height often 3' or less. Growing season FMH-plot tree data showed only 9% mortality in the poles and 5% mortality of overstory trees as compared to plot sampling collected in 2018 (**Figure 18**).

A few areas of high severity were observed, primarily along the west slope, with various degrees of torching in the shrub layer and occasionally overstory pines, and char heights often exceeding 6' (sometimes 50-75%+ of the overall tree height) resulting in localized overstory mortality (**Figure 19**).



Figure 19. Photo of high in severity oak-pine forest on west side of the burn.

Conversely, fire was allowed to back down into many of the deep drainages along the east side of the unit often going out in the compact mixed hardwood litter near the base of the slope. Fire burned with moderate intensity across much of the south slope, which contains sparse overstory and areas with a relatively diverse herbaceous layer.

An extended burn severity map (**Figure 1**) was processed for this burn, largely agreeing with field observations of overall low to very low severity with scattered patches of moderate and high severity along the west slope and a larger block of high to moderate severity on the south end of the unit in the more open areas where the sparse overstory exposed more of the understory effects thereby exaggerating the severity.

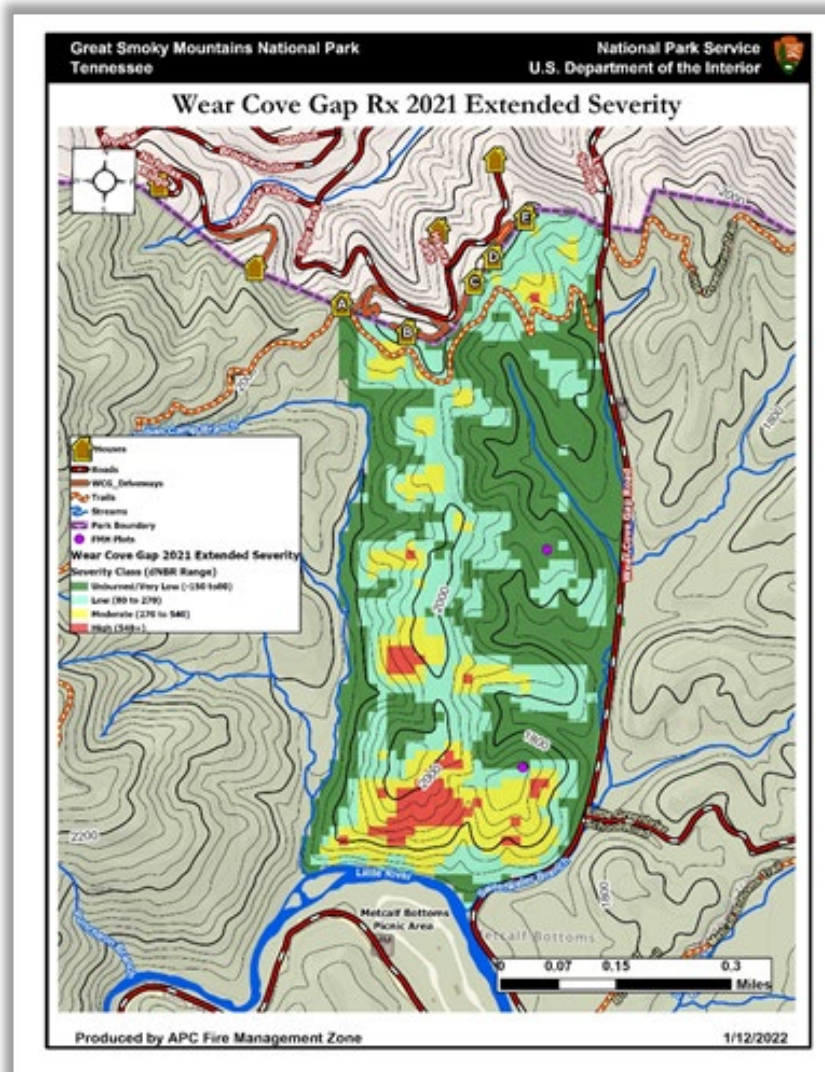


Figure 20. Extended Burn Severity Map of 2021 Wear Cove Gap Rx Burn.

The objectives for this burn unit were generally met with excellent reduction of the leaf litter and top-kill of the shrub layer. Overstory oak and yellow pine were retained over the majority of the burn area although ignition techniques used along parts of the west slope did result in localized patches of overstory mortality.

The burn was also effective at top-killing encroaching woody stems along the more barren portions of south slope where herbs and grasses are relatively more abundant (**Figure 21**). However, a 12-year span between burns has allowed resprouting woody stems to gain a significant presence on this site. Future expansion of herbaceous species in this area, and across the burn unit in general, will rely on more frequent applications of fire and possibly variation in seasonality of burns.



Figure 21. Example of effects on the southern slope of the burn with a sparse overstory and midstory an understory of tree seedlings, low shrubs and scattered grasses and herbs which were generally resprouting after being top-killed by the burn.

Key Observations:

1. Top-kill of the tall mountain laurel and rhododendron shrub layer was wide-spread across the burn
2. Overall severity was low with good retention of overstory oak and yellow pine although firing technique used on the west slope of the unit did result in localized canopy gap creation
3. 12 years is too long between treatments, allowing hardwood resprouts to proliferate in the understory, future treatments should be frequent, and use of growing season burning might prove helpful in reducing understory woody resprouts
4. The combination of long-term monitoring plots, Survey123 Rapid Assessment monitoring, and burn severity mapping provide an effective way to monitor site-specific fire effects as well as programmatic fire effects throughout the park.

Primitive Baptist Prescribed Burn

The Primitive Baptist prescribed burn unit (338 acres) was burned on 2/25/21. This unit consisted of a large field complex dissected by two sizeable woodlots, Feezell Branch, and an unnamed stream running adjacent to Hyatt Lane (**Figure 22**). The unit is bounded by a stretch of the Cades Cove Loop Road to the north, the Primitive Baptist Church access road and a section of handline and mowed field edge on the east, Hyatt Lane on the west, and Abrams Creek to the south. The wooded areas varied from white oak to successional mixed hardwood timber litter

fuels with significant areas of encroaching white pine stems in the understory and moderate to heavy woody fuel loading from past southern pine beetle mortality. The field areas were generally open with moderate to heavy grass fuels, especially in the southern fields, and included some areas of encroaching hardwoods and yellow pine particularly in the northwest corner. Additionally, the strip of field encompassing Feezell Branch had significant encroachment of tulip poplar and some red maple stems with lighter grass fuels. Of final note, the Cades Cove Primitive Baptist Church is a historic structure located within the woodlot on the eastern edge of the unit.

The unit has burned in parts or entirety starting in the spring of 2000, 2009, and 2021. The P.B.C. unit has also burned during the fall in 2011, and 2016, as well as Mechanical treatment of hardwoods near Feezell Branch in the Summer 2021 depicted in **Figure 22** as a blue inlay polygon.

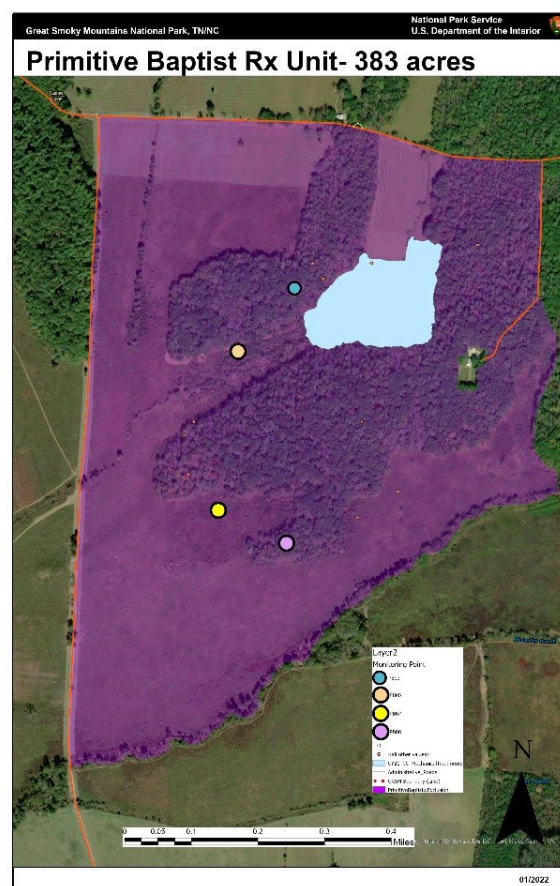


Figure 22. Map of Primitive Baptist Church Rx area (in purple) and subsequent mechanical treatment (blue).

The Primitive Baptist Church unit was attempted to be burned in its entirety (**Figure 1**) for the first time where all woodlots were included in the burn. Other burns included some woodlots, but not around the historic church, as it did this Rx burn.

With most of the overall burn objectives achieved, the 3 key monitoring points are as follows:

1. The fields burned very well where there wasn't heavy hardwood encroachment. However, please see **Figure 26**.
2. The woodlots generally did not burn, except small areas where fluffy mixed oak litter existed on the south facing sides of the spurs
3. The area with larger diameter tulip poplar encroachment burned around the edges but, generally remained unphased by the burn. Consequently, a mechanical treatment followed in this area

As expected, the fields that were comprised of heavy graminoid and forb thatch burned extremely well with the unanticipated lower Relative Humidity of 38% and 3 days since rain. The coverage of burn in the field portion of the units was estimated as >95% and consumption of fine fuels was 85%-95%. This is illustrated in the photo series below with **Figures 23 & 24**. Commonly, as firing moved further south and passed woodlot spurs, the fire naturally pushed from the fields into woodlots. At this point, fire behavior lessened into a backing fire.



Figure 23. Field portion of unit during firing and typical fire behavior.



Figure 24. A field following burning, showing high fuel consumption.

One area scouted following the burn was a section of the unit that had missed approximately 10 years of treatment with mowing and fire. This area of hardwood (mostly tulip poplar- *Liriodendron tulipifera*) encroachment is in between the northernmost woodlot and the southern woodlot centered around Feezell branch. Although the fire burned through this area, this hardwood encroachment area had larger (> 6cm DBH) stems of tulip poplar which remained unharmed by the burn (**Figure 25**). Part of this area was masticated during August of 2021.



Figure 25. Area of large hardwood encroachment showing good fire spread; however these trees were not top-killed by this low-intensity fire. Mastication was completed in part of this area during summer 2021.

Less than one year after the prescribed burn of Primitive Baptist Church, significant woody encroachment was still observed in the northwestern part of the unit (**Figure 26**). It appears these woody stems survived the burn, which is a bit surprising. Nevertheless, but it may point to a need to re-burn or mow this portion of the sooner than the typical 3-year rotation.



Figure 26. Encroachment in Primitive Baptist Church 7 months following burn.

Overall, burning in the woodlots was nonexistent to patchy. Objectives for fuel consumption and reduction of saplings were not met due to the shading and overall arrangement of fuels in most of the woodlots. Some fire crept into the south facing portions of the woodlots associated with more exposed dry oak litter, and good consumption occurred in those areas, although most areas burned very minimally. **Figure 27** shows a typical woodlot with minimal fuel consumption.



Figure 27. Minimally burned woodlot in the Primitive Baptist Church burn unit.

An exciting observation from the monitoring of the Primitive Baptist unit was the abundance of American Columbo (*Frasera carolinensis*) located in a woodlot that, unfortunately, remained mostly unburned (**Figure 28**). The population is fairly large, but most plants appear to only grow vegetatively and not many flowering stems were observed. The woodland where the population is located has grown very dense in the midstory and understory (**Figure 29**), and lack of fire is likely contributing to a decline in the population. Additional monitoring is needed. Deer herbivory is another factor that has been shown to impact Columbo populations. A follow-up visit is recommended to observe whether the plants flower or not in middle to late May. One suggestion is to target the area and allow fire to move further into this woodlot in future burns.



Figure 28. Close-up photo of *Frasera carolinensis*.



Figure 29. Columbo plants surrounded by dense woody vegetation.

As always, monitoring efforts always include surveys for invasive species. Exotic species such as Callery or Bradford Pear (*Pyrus calleryana*), Oriental Bittersweet (*Celastrus orbiculatus*), Multiflora rose (*Rosa multiflora*) were found throughout the unit and the Vegetation Management Team was notified. Bradford pear is problematic when left untreated in old fields especially where the parent geology tends to be limestone.

Following the mechanical treatment in August, an additional qualitative monitoring trip of the unit was completed in September. One interesting observation from this work was the response of common milkweed (*Asclepias syriaca*) to the mastication treatment. This is particularly interesting because of the ongoing concern about management of habitat for monarch butterflies, which depend on milkweed. In areas of light mastication, common milkweed was observed to be responding well, growing back noticeably faster than any other plant species (**Figure 30**).



Figure 30. *Asclepias syriaca* (common milkweed) seemed to respond exceptionally well to light mastication treatment during the mid-summer. Many plants (10s to 100s) were observed in the treated area.

Even in another, more heavily masticated area, common milkweed was one of the few species even growing back in one month after the treatment (**Figure 31**).



Figure 31. Common milkweed growing back quickly following heavy mastication.

Monitoring Fire Effects in Methodist Church Burn Unit

The Methodist Church unit was burned in fall of 2020, and was also completely mowed in August 2021. The field was mowed by Park maintenance staff with additional mastication and mowing by Cherokee National Forest (USFS) collaborators.



Figure 33. Methodist was completely mowed following a burn in fall 2020

Key observations following the 2020 Methodist Rx:

- Fire effects in Methodist woodlots were generally not beneficial. These woodlots are successional forest occupied by species that aren't necessarily fire-adapted, and the presence of invasive, non-native species was exacerbated by the pronounced effects on the midstory and understory. In particular, populations of Japanese stilt-grass (*Microstegium vimineum*) appear to have expanded tremendously following the burn (**Figure 34**).



Figure 34. Basal damage to fire-sensitive trees and large expanse of Japanese stilt grass.

Long-Term Monitoring Results

Table 8. Objectives and long-term monitoring results for GRSM. No updates from last year's report.

Monitoring Type	Management Objective Restoration Phase- (After 4 burns)	Monitoring Results (80% confidence intervals)	Progress Towards Meeting Objectives	Year Last Analysis Completed
Yellow Pine Woodland (FPIR11) <i>29 Total Plots</i> <i>28 have burned once</i> <i>17 have burned twice</i> <i>5 have burned three times</i> <i>1 remains unburned</i>	>50% Reduction in total fuel loading	Total fuel reduction: After 1 burn (n=27): 34% ($\pm 7\%$) After 2 burns (n=16): 37% ($\pm 6\%$) After 3 burns (n=5): 15% ($\pm 26\%$)	Objective may need to be revised.	2018
	>70% Reduction in pole-sized tree density	Pole reduction: After 1 burn (n=28): 51% (± 8) After 2 burns (n=15): 77% (± 6) After 3 burns (n=5): 60% (± 27)	Trend is very positive. More data are needed.	2018
	25-50% Reduction in overstory tree density	Overstory reduction: After 1 burn (n=28): 18% (± 7) After 2 burns (n=15): 50% (± 13) After 3 burns (n=5): 10% (± 18)	Trend is very positive. More data are needed.	2018
	>200 tall (>1m) Yellow Pine seedlings /ac	Yellow Pine Seedling Density: Preburn density (n=28): 0 After 1 burn (n=24): 631/ac (± 300) After 2 burns (n=15): 1237/ac (± 849) After 3 burns (n=5): 130 (± 198)	Trend is positive. High variability.	2018
	>40% Cover by native herbs/subshrubs	Preburn cover: 3% ($\pm 1\%$) (n=23) After 1 burn (n=23): 11% ($\pm 4\%$) After 2 burns (n=9): 10% ($\pm 6\%$)	Trend is positive.	2009
Dry Oak Forest (FQUCO1) <i>24 total Plots</i> <i>17 have burned once</i> <i>10 have burned twice</i> <i>5 have burned three times</i> <i>7 remain unburned</i>	>50% Reduction in total fuel loading	Total Fuel reduction: After 1 burn (n=15): 29% (± 4) After 2 burns (n=7): 27% (± 17) After 3 burns (n=5): 26% (± 18)	Objective may need to be revised.	2018
	>70% Reduction in pole-sized tree density	Pole reduction: After 1 burn (n=17): 45% (± 10) After 2 burns (n=9): 49% (± 13) After 3 burns (n=5): 77% (± 16)	Trend is very positive. More data are needed.	2018
	15-30% Reduction in overstory tree density	Overstory reduction: After 1 burn (n=17): 5% (± 5) After 2 burns (n=9): 9% (± 11) After 3 burns (n=5): 7% (± 11)	Trend is very positive. More data are needed.	2018
	>200 tall (>1m) Oak seedlings /ac	Oak Seedling Density: Preburn density (n=17): 71 (± 66) After 1 burn (n=17): 229/ac (± 180) After 2 burns (n=9): 279/ac (± 152) After 3 burns (n=5): 16 (± 25)	Trend is very positive. High variability.	2018
	>30% Cover by native herbs/subshrubs	Preburn cover (n=9): 4% ($\pm 2\%$) After 1 burn (n=9): 4% ($\pm 2\%$)	No change detected.	2011

King Mountain National Military Park (KIMO): 2021 Fire Effects Monitoring Annual Report

Activity Summary

During 2021, the APC Zone Fire Ecology team supported KIMO with fire operations, fire planning, GIS, and fire effects monitoring. The team participated and provided leadership for the Battlefield and Partner prescribed burns in the spring of 2021. The Fire Ecologist assisted the Park in updating the Fire Management Plan in 2021 and provided support for a more comprehensive update for 2022. The Lead Monitor and Assistant Lead provided substantial GIS support for the fire program, providing detailed maps for all fuels projects, submission of maps for all completed fuels projects, and severity mapping for the Battlefield prescribed burn.

Highlights from 2021 fire effects monitoring included detailed monitoring of the Battlefield burn, scouting of upcoming burn areas including WTP and Piedmont, and consulting on the ongoing grassland restoration project. Monitoring of the Battlefield prescribed burn is discussed further in the “Review of 2021 Projects” section of this report. The focus of our program in the coming year will be to provide operational and monitoring support for any prescribed burns or non-fire fuels-management projects at KIMO. The other priority will be to complete the summer monitoring for any plots that burn during the 2022 burn season.

Review of 2021 Projects

Battlefield Prescribed Burn

The Battlefield prescribed burn (200 acres) was completed on 4/14/21. This marks the 4th entry for this unit with a 14-year lapse since the last treatment (3/22/07). The historic battlefield ridge is a prominent landform running through the middle of the unit SW to NE with several spur ridges and elevations ranging approximately from 800’-1000’.

The unit is bounded by Main Park Dr to the west and south, and a combination of Y&S Rd and hiking trails to the north and west. The park visitors center (VC) is located directly adjacent to the unit on the east side and the park headquarters building is just across Main Park Dr from the west side of the unit. Accessed from the park VC, a paved loop trail passes along the foot of the slope on the N side of the main battlefield ridge and ascends up to and across the ridgeline passing by several monuments, including 2 tall spires commemorating the battle.

Oak forests dominate much of the unit, particularly the northern half, however there is significant cover of shortleaf pine on the south and west facing slopes of the main ridge. Moderately dense and tall hardwood resprouts were present in much of the unit understory along with areas of dense mountain laurel on the north slope of the main ridge and scattered patches of pine regen on

the south slopes. Greenup was underway at the time of the burn and leaf-out of deciduous species was over halfway complete.

Despite partial shading and moderate humidity at the start of the burn, fire carried exceptionally well throughout the day across the entire unit with low to moderate intensity. Generally, the leaf litter was completely consumed, with 1-hr and 10-hr fuels also consuming later in the day.



Figure 35. Example of average fire behavior during the burn.

Scorch of understory woody tree resprouts was generally high, with significant top-kill throughout the burn area.



Figure 36. Example of widespread top-kill of dense understory tree seedlings, notice the line of dead brown stems just under the lower limbs of the upper canopy. This represents achievement of one of the key objectives of this burn.

The dense mountain laurel along the north slope of the main ridge was also heavily scorched and top-killed across nearly the entire slope.



Figure 37. Example of top-kill in the dense mountain laurel shrub layer along the N slope of the main ridge.

Fire intensity increased in the afternoon with lower relative humidity and the transition to the drier yellow pine fuels on the south side of the battlefield ridge. Fire carried through the pine and oak-pine stands of the southern slope and spur ridges with moderate to occasionally high intensity resulting significant top-kill of the understory and even the midstory in some areas.



Figure 38. The southern slope burned with notably greater intensity resulting heavy thinning of both the understory and even midstory in places.

Even with the greater intensity observed on the south portion of the unit, overstory mortality remained low across the burn. An extended burn severity map was produced for the burn (**Figure 39**), which shows good correlation to observations from the summer field season. The majority of the unit displays very low severity with impacts restricted to the understory, while areas containing some component of yellow pine in the canopy (primarily the south slope of the main ridge as well as a broad spur in the NE corner of the unit) typically showed slightly elevated severity due to thinning of both the understory and midstory.

FMH plot data showed an overall 84% mortality in pole sized trees and 0% mortality in overstory. However, when comparing individual plots, this reduction in midstory canopy is only observed in the 2 plots that fall within pine areas while the 3rd plot was more typical of the many of the oak forests throughout the unit with no mortality in mid- to upper canopy.

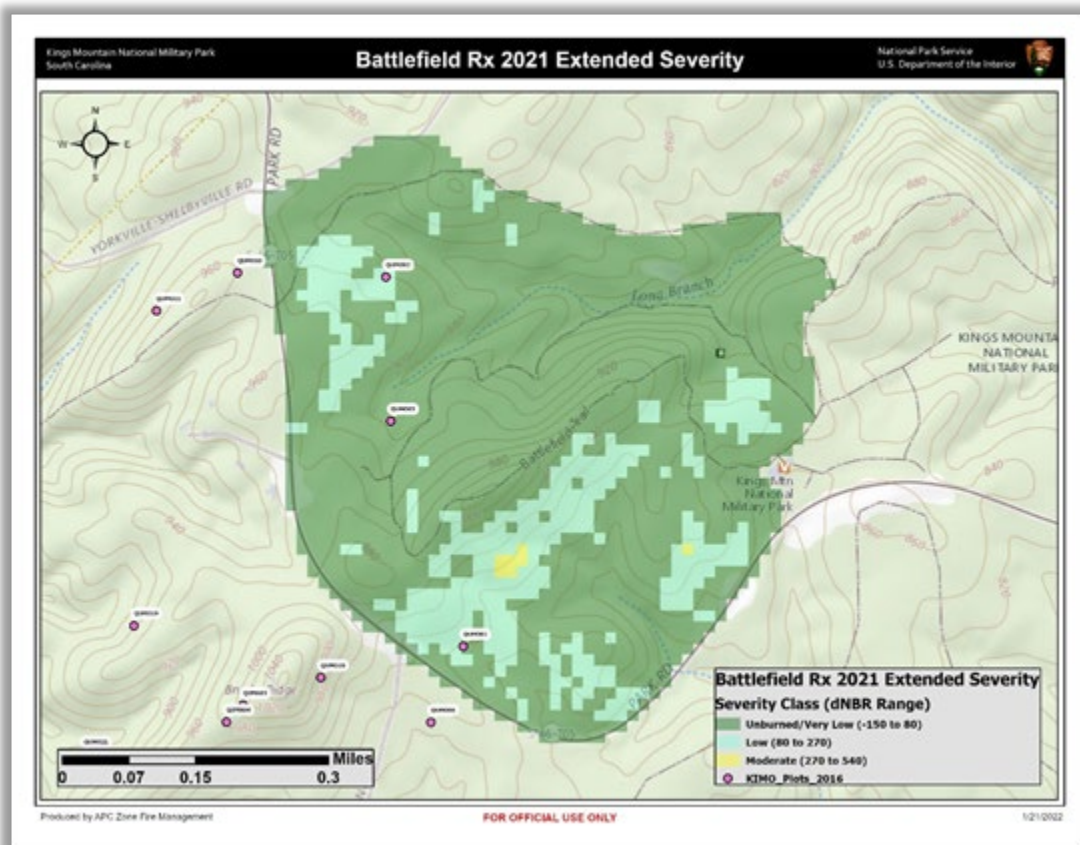


Figure 39. Map of the extended burn severity for the 2021 Battlefield Rx Burn

Shortleaf pine is a key species in the pine forests and was frequently observed to be resprouting where top-killed or occasionally putting out new needles following heavy scorch. Regeneration of shortleaf pine within the Battlefield burn as well as many other burn areas in the park has been a great success over the history of the burn program, and given the species' ability to resprout it now seems well positioned to eventually replace the existing shortleaf overstory. Loblolly pine is

also common in the pine forest along the southern slope of the unit, however, it appears to have moved into the drier upper slopes from the drainages and lower protected slopes during years of fire suppression. While loblolly does not resprout and is much less tolerant of frequent fire compared to shortleaf pine, it does grow rapidly and is a prolific seeder. Some of the smaller loblolly stems were completely killed by the burn but several larger midstory and overstory stems persisted and will continue to compete with shortleaf unless more frequent application of fire is used.

Overall, this burn was a great success, meeting single-burn objectives for fuel reduction and top-kill of understory woody stems and thinning of mid-story within the target communities while retaining overstory oak and pine. It was an especially successful return of fire to the site after a 14-year hiatus.

Key Observations:

1. Early growing season burns continue to be very effective given favorable weather conditions (lower humidity and high dispersion)
2. A thoughtful ignition strategy and experienced firing personnel helped complete the burn in a timely and safe manner while still meeting all the burn objectives
3. Shortleaf pine regeneration has been very successful following prior burns of this area and given the excellent understory and midstory thinning from the most recent burn, it is well positioned to eventually replace the existing overstory
4. While the 14-year lapse between burns has allowed shortleaf to become well established, competition from loblolly pine and various hardwood resprouts has also proliferated. More frequent application of fire is recommended to keep this competition in check and help favor shortleaf pine and oak regeneration.

Partner 'Small' Prescribed Burn

The Partner Small Rx burn was attempted on 5/18/21. This burn area is a small subunit of the larger Partner burn, which was divided due to time constraints and extensive prep needs along the south boundary of the unit caused by storm damage. The unit is a narrow strip of mixed forest types including chestnut oak, mixed oak-hardwood, shortleaf pine and successional pine forest, which is bounded by Main Park Drive and a parallel hiking trail.

Marginal weather conditions including elevated humidity along with shading from full green-up resulted in a largely unsuccessful burn with fire only carrying in narrow strips and scattered small patches. An attempt at burning the original full size Partner Rx Burn Unit is expected in the near future.

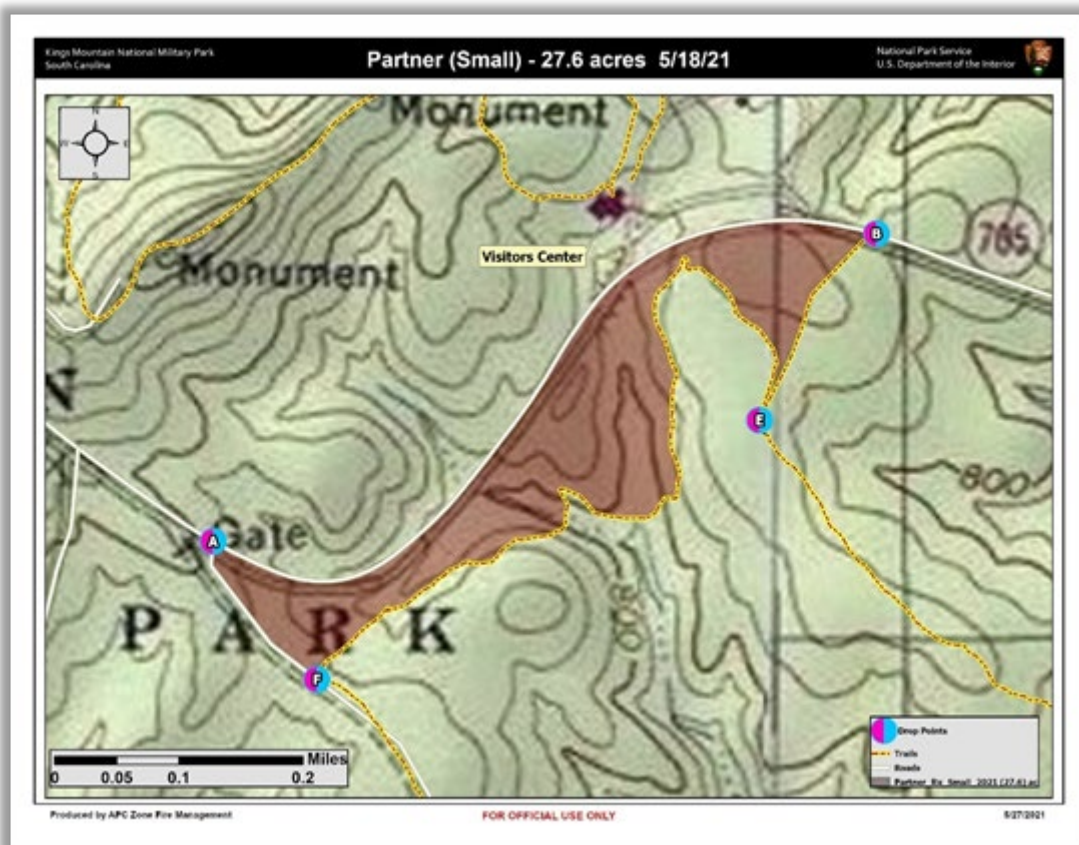


Figure 40. Map of the 2021 Partner Small Rx

Long-Term Monitoring Results

Table 9. Objectives and long-term monitoring results for KIMO. No updates to the table from last year's report.

Monitoring Type	Management Objective Restoration Phase- (After 4 burns)	Monitoring Results (80% confidence intervals)	Progress Towards Meeting Objectives	Year Last Analysis Completed
Dry Oak Forest (FQUM01) <i>21 plots: 20 have burned once 19 have burned twice 17 have burned 3 times 9 have burned 4 times</i>	>50% Reduction in total fuel loading	Total fuel reduction: After 1 burn (n=19): 40% ($\pm 6\%$) After 2 burns (n=18): 46% ($\pm 5\%$) After 3 burns (n=17): 57% ($\pm 5\%$) After 4 burns (n=7): 61% ($\pm 6\%$)	Trends suggest that the objective is being accomplished after 3 burns	2018
	>70% Reduction in pole-sized tree density	Pole reduction: After 1 burn (n=20): 42% (± 9) After 2 burns (n=17): 58% (± 8) After 3 burns (n=15): 71% (± 7) After 4 burns (n=5): 76% (± 12)	Trends suggest that the objective is being accomplished after 3 burns	2018
	15-30% Reduction in overstory tree density	Overstory reduction: After 1 burn (n=20): 7% (± 4) After 2 burns (n=17): 11% (± 5) After 3 burns (n=17): 21% (± 7) After 4 burns (n=6): 26% (± 16)	Trends suggest that the objective is being accomplished after 3 burns	2018
	>200 tall (>1m) Oak seedlings/acre	Oak Seedling Density (stems/acre): Preburn density (n=15): 183 (± 132) After 1 burn (n=20): 77/ac (± 47) After 2 burns (n=17): 233/ac (± 171) After 3 burns (n=16): 182 (± 137)	Insufficient data. High variability. Objective needs to be revised to include shortleaf pine seedlings.	2018
	>15% Cover by native herbs/subshrubs	Preburn cover (n=19): <1% After 1 burn (n=19): 1% After 2 burns (n=19): 1-2%	No change, but more burns are needed.	2009
Chestnut Oak-Blackjack Oak Woodland (FQUMA1) <i>8 plots</i>	>50% Reduction in total fuel loading	Total fuel reduction: After 1 burn (n=7): 47% ($\pm 4\%$)	Trend is positive.	2009
	>70% Reduction in pole-sized tree density	Pole reduction: After 1 burn (n=8): 45% ($\pm 12\%$) After 2 burns (n=4): 62% ($\pm 12\%$)	Trend is positive.	2009
	15-30% Reduction in overstory tree density	Overstory reduction: After 1 burn (n=8): 30% ($\pm 11\%$)	Trend is positive.	2009
	>30% Cover by native herbs	Preburn cover (n=7): 6% Cover after 1 burn (n=7): 9%	No change, but more burns are needed.	2009

Moore's Creek National Battlefield (MOCR): 2021 Fire Effects Monitoring Annual Report

Activity Summary

During 2021, the APC Zone Fire Ecology team supported MOCR with a burn program review, fire planning, and fire effects monitoring. The Fire Ecologist attended an early-year meeting with Park managers to discuss changes to the prescribed burn program. The Ecologist also assisted the Park in updating the Fire Management Plan in 2021 and provided support for a more comprehensive update for 2022. The Lead Monitor and Assistant Lead provided substantial GIS support for the fire program, providing detailed maps for all fuels projects, submission of maps for all completed fuels projects, and severity mapping for a number of past prescribed burns.

Highlights from 2021 fire effects monitoring included a site visit with detailed monitoring of all of the burn units in the Park. This monitoring effort featured our Rapid Assessment Monitoring, which collects data electronically with the Survey123 app. The results of this monitoring are discussed further in the "Review of 2021 Projects" section of this report. The focus of our program in the coming year will be to provide operational and monitoring support for any prescribed burns or non-fire fuels-management projects at MOCR. The other priority will be to complete the summer monitoring for any units that burn during the 2022 burn season.

Review of 2021 Projects

The Fire Ecology Team visited the Park in June, and conducted Rapid Assessment monitoring using a form created in Survey123. This method allows us to range widely through large areas, in this case the entire Park, collecting data and photos from any or all burned areas. The data are georeferenced, and are associated with points in ArcGIS Online, creating a product that combines maps, photos, and tabular fire effects data on fuels and vegetation. These data can then be analyzed to build and communicate greater understanding of fire ecology, fire effects, and best management practices.

During our June visit, we surveyed all three of the active burn units at MOCR, collecting Rapid Assessment data at 6 separate plots. Our goal was to ascertain the current condition of the vegetation and fuels in each burn unit, and determine if the prescribed burn program is achieving the park's objectives. Brief evaluations based on this monitoring are provided for each unit. The burn plan objectives and map of the MOCR units is provided for reference (**Figure 41**).

Burn Plan Objectives (applied to all burn units):

1. Use low intensity fire in areas where Atlantic White Cedar are present
2. Reduce overstory / midstory vegetation density by 40-70%
3. Reduce litter load by >70% in over >75% area of target vegetation
4. Reduce woody encroachment in Savanna unit by >50%
5. In the long term, reduce overstory by 15-30% without creating large gaps in the canopy.

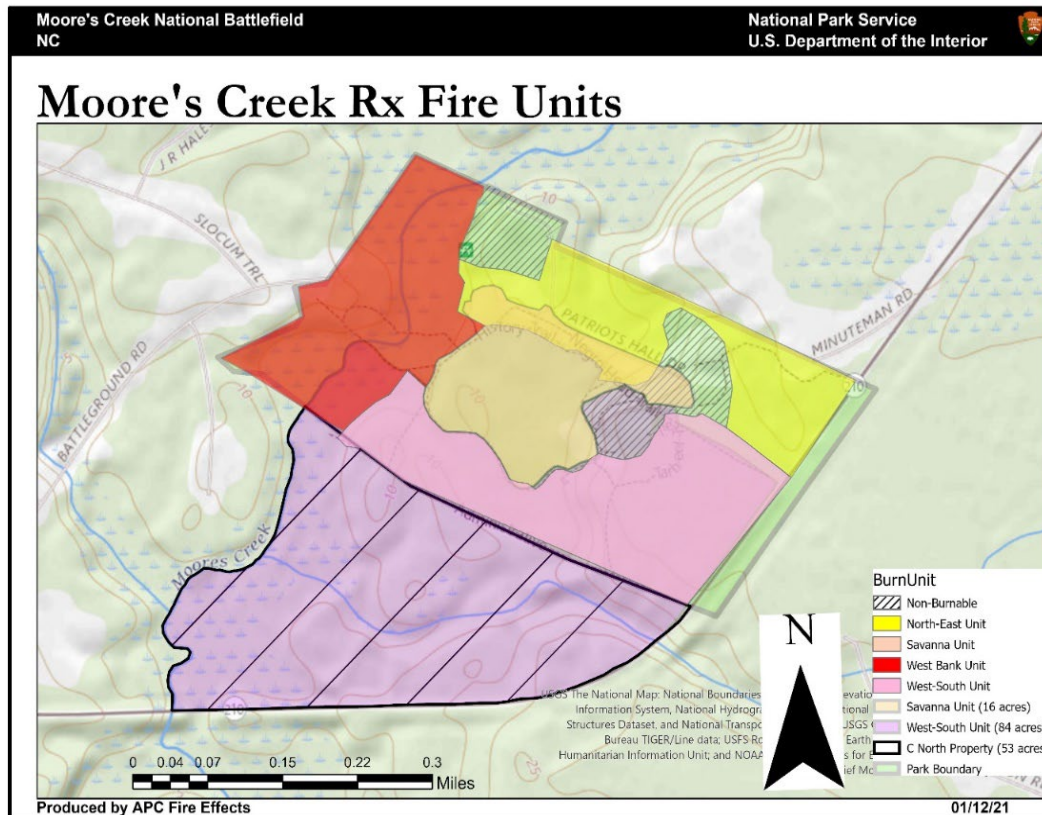


Figure 41. Prescribed-Burn units of Moore's Creek NB.
Private lands included in 2020 burning also shown ("C North Property")

Savanna Burn Unit

The first site evaluated was the Savanna unit, which has been the focus of the Park's prescribed burn program for over 20 years. This unit is listed as 12 acres, though only about half of that can be considered wet savanna. It has been burned annually since 2016, and was last burned in late April of 2021. The primary site is a grass/sedge-dominated wetland, and it is surrounded to the west by a young, dense stand of loblolly pine. Monitoring in 2021 was focused on the grass-dominated wetland. The objective that seems most applicable to the Savanna unit is: Reduce woody encroachment in the Savanna by >50%.

Visual inspections and data from two Rapid Assessment plots in the Savanna provide clear evidence that the 2021 prescribed burn met the objective for reducing woody encroachment (**Figure 42**). The annual burning of this site has been very effective at limiting woody encroachment and has allowed native grasses, sedges, and forbs to increase in cover and productivity compared to observations made 10 years ago. Monitoring indicates that the native herbaceous diversity of this site is quite high, and includes a number of plant species that are characteristic of high-quality coastal plain wet savannas. These plants include sundews

(*Drosera*), grass pink orchid (*Calopogon*), yellow-eyed grass (*Xyris*), pipewort (*Eriocaulon*), Carolina redroot (*Lachnanthes*), spreading pogonia (*Cleistesiosis*), and many others. Our surveys did not locate Venus flytrap or pitcher plants, which have both been reported for this site. The site is exceptional, and it appears that annual burning is providing a great benefit to the structure, function, and diversity of this site. Additional botanical surveys and thoughtful management are recommended.



Figure 42. This photo from Survey123 Rapid Assessment Monitoring was taken on June 8, 2021 during the first growing season following the burn. The image illustrates that the burn met objectives by top-killing nearly all pole-sized sweetgum. This site is quite diverse with a number of high-quality native grasses, sedges and forbs, including grass pink orchid and large populations of sundews (*Drosera* spp.). Vegetation and fuels data associated with this point can be viewed in ArcGIS online.

South/West Burn Unit

The South/West unit has been burned four times since 2014, and was last burned in 2020. This unit is dominated by even-aged loblolly pine forest, with occasional hardwoods, longleaf pine, and pond pine. The upper midstory is quite open, possibly as a result of repeated burning. However, there are large amounts of resprouting sweetgum and a variety of other woody trees and shrubs in the lower midstory (**Figure 43**).

The overall structure of this unit is excellent, with pine canopy cover of 25-50% and an open midstory. These open conditions have allowed native grasses like switch-cane (*Arundinaria*

tecta) and wiregrass (*Aristida beyrichiana*) to increase in cover. There are also small patches of longleaf pine seedlings and regeneration in the ‘South’ portion of the unit.

There are several areas where overstory mortality has created multiple-tree canopy gaps, including in the small population of mature Atlantic white cedar. Monitoring of the Atlantic white cedar revealed only a single living individual, and continued protection of this tree during prescribed burning is recommended. In addition, care should be taken to limit additional mortality of the pine canopy, which is most likely to occur in and around those existing canopy gaps. These stands are already quite open, and additional canopy gaps could negatively impact ecological processes, park aesthetics, and safety.



Figure 43. Mixed pine woodland in the South/West burn unit. This photo illustrates the open upper midstory conditions, and the dense, fast-growing woody resprouts in the lower midstory. Though the woody species in the understory vary across the unit, this overall structure is typical of the South/West burn unit. This photo was taken during the second growing season after the 2020 prescribed burn.

North/East Burn Unit

The North/East unit was burned in spring 2021, and has been burned a total of three times since 2017. The vegetation in this unit is forested, but is considerably different from the other forested unit, South/West. The North/East unit has wetter soils, and is composed of a mix of bottomland hardwoods, young successional loblolly pine, and mixed loblolly pine/hardwoods. Due to these vegetation differences, this unit has a different fire ecology, and prescribed burning practices

should be different than they are for South/West. In general, ignition should be limited to very low intensity fires, and fire should not be forced or allowed to run into areas with bottomland hardwood trees.

Even moderate-intensity burning can lead to mortality or significant damage to sensitive hardwoods, such as water oak (*Quercus nigra*). These thin-barked trees can sustain significant basal damage from 4-6' flames that will lead to crown dieback, attack from secondary agents like rot fungi or boring insects, and eventual mortality (**Figure 44**). Major limbs and trunks of these trees can subsequently contribute to increased fuel loading on the site.



Figure 44. Water oak showing extensive basal damage and decline from moderate intensity burning. Using backing fires with flame lengths less than 1-2' should prevent this type of damage to hardwoods in the North/East unit.

Summary

This year's monitoring was our first attempt to conduct structured monitoring of fire effects on vegetation and fuels at Moores Creek. We'll need more years of monitoring to understand the trends in fire effects and vegetation change, but some important points come from this year's work:

1. Burning has been very beneficial for structure and diversity of the Savanna unit. Continued annual burning is recommended.
2. Burning has created more open stand conditions in South/West, though rapidly-growing tree sprouts and shrubs dominate the understory vegetation. These woody plants will grow into a very dense midstory unless frequent burning is continued.
3. Burning in the North/East unit should be limited, or done very carefully. The vegetation in this unit is not as tolerant of burning as other parts of the park, and the presence of fire-damaged/killed oak near the park entrance poses ecological and aesthetic concerns.
4. Objectives may need to be revised when the burn plan is updated. Specifically, “reduction of overstory vegetation density by 40-70%” is excessive, and would not be an acceptable result at Moores Creek. Additionally, objectives may need to be updated to reflect changes in vegetation after 10 years of burning.
5. Rapid Assessment monitoring provided an effective and efficient way to conduct fire effects monitoring at Moores Creek. Vegetation monitoring by the Southeast Coast I&M Network in the coming year will provide opportunities for additional discussions about the long-term goals and objectives for MOCR.

Outer Banks Group (OBG): 2021 Fire Effects Monitoring Annual Report

Includes: Fort Raleigh National Historic Site (FORA), Wright Brothers National Memorial (WRBR), and Cape Hatteras National Seashore (CAHA).

Activity Summary

During 2021, the APC Zone Fire Ecology team supported OBG with fire planning, RAWS maintenance, and fire effects monitoring. The Ecologist assisted the Park in updating the Fire Management Plan in 2021 and provided support for a more comprehensive update for 2022. The Lead Monitor and Assistant Lead provided substantial GIS support for the fire program, providing detailed maps for all fuels projects, submission of maps for all completed fuels projects.

Field work completed in 2021 included a site visit in December to replace sensors in the new Buxton RAWS, and conduct fire effects and fuels-treatment monitoring. This monitoring effort featured Rapid Assessment Monitoring of the Fort Raleigh fuel break, qualitative monitoring of the 2015 Little Kinnakeet wildfire, and a boundary assessment of Wright Brothers. A highlight from the monitoring work was the “discovery” of a small stand of longleaf pine along the Heritage Point boundary at Fort Raleigh. It is likely that this was a known population, but our team had not been able to locate the stand over the past 10 years of field work at OBG.

Other results of this year’s monitoring are discussed further in the “Review of 2021 Projects” section of this report. The focus of our program in the coming year will be to provide operational and monitoring support for any fuels-management projects at OBG.

Review of 2021 Projects

Buxton Housing Area - Defensible Space Fuel Treatments

For FY21, an ONPS-funded project occurred at the Buxton employee housing area near Loggerhead Lane. Three separate treatment areas are associated with this project and depicted in **Figure 45** below. The project was completed by contractors and essentially dealt with removing hazard trees and pruning of vegetation against the CCC housing area off Cabin Road. There was overlap with the 2018 thinning project, and the ONPS FY21 project appears to be a supplement to the prior project and a continued removal of flammable vegetation adjacent to housing. The removal of vegetation and total treated acres is approximately 3 acres.

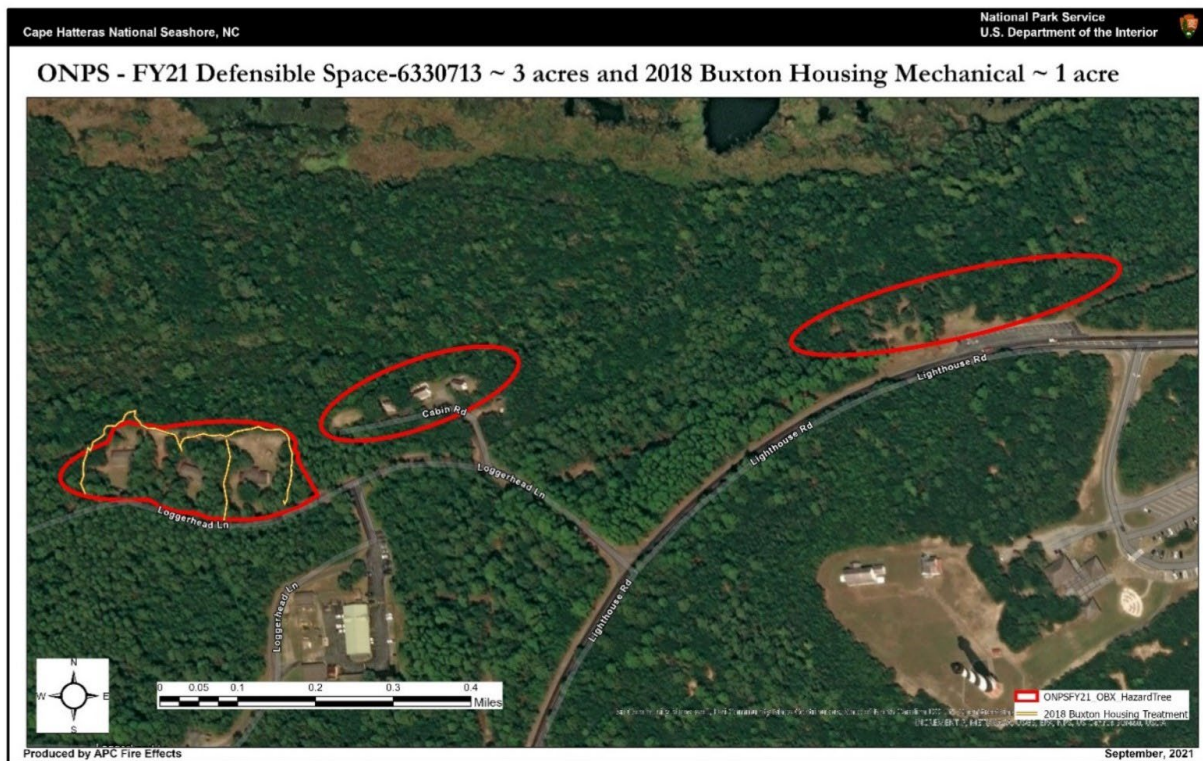


Figure 45. Buxton Housing Fuels Treatments

Little Kinnakeet Wildfire Monitoring

The Little Kinnakeet wildfire occurred on Hatteras Island just north of Avon during the summer of 2015 (**Figure 46**). The fire occurred in a NC State Natural Area identified in Dare County's Natural Heritage registry document. The entire Natural Heritage area is comprised of a 2.5 mile stretch west of Highway 12 and contains Interdune swales with Maritime dry grasslands and Maritime shrub communities. These communities house a significantly rare witch-grass (*Dichanthelium aciculare ssp*) and watch list species saltwater false willow (*Baccharis angustifolia*). The fire, although small in size (15ac), had significant effects on the vegetation, which was, prior to the fire, dominated by southern juniper and other shrub species.

In **Figure 47**, the distinct pattern detected by aerial imagery clearly depicts the heavy top-kill of shrubs such as juniper and wax myrtle. This fire was monitored in 2015, and reported on in the 2015 Fire Ecology Annual Report. A follow-up visit occurred in December 2021 to review effects from the fire almost 6 years later.



Figure 46. Map for 2015 Little Kinnakeet WF. Yellow dots are 2021 photo points.



Figure 47. 2017 Google Earth imagery illustrating post-fire vegetation change.

Observations from the 2021 visit noted a remarkable increase in diversity and cover in the burned area compared to the Dry shrub/ grassland observed in adjacent, unburned areas. The reduction of juniper cover and the strong grass response was already evident during monitoring in late 2015 (**Figure 48**).

Figure 49 depicts great response by both grasses and forbs three years following the fire. **Figure 50** is an aerial image from drones deployed on the Hurricane Dorian Incident. The lower left of the figure depicts high top-kill of shrubs and graminoid response. The last **Figure 51** depicts how the wax myrtle (*Myrica cerifera*) resprout is almost returning to pre-fire heights. The cedar top-kill was permanent, and few new seedlings were detected.

A follow-up monitoring survey for an increased response from state-listed rare plants or newly detected species is needed. One possible consequence of the fire and its subsequent effects was the surrogate role it played in disturbance ecology in lieu of the natural process of dune over-wash on this narrow barrier island.



Figure 48. Reduction of juniper and grass response 3 months after the fire. 2015.



Figure 49. Monitoring in 2018 shows that many of the heavily scorched cedars observed in 2015 subsequently died and did not resprout. It also showed a dense and diverse herb response.



Figure 50. UAS (drone) imagery



Figure 51. A photo taken from the southern end of the wildfire site in December 2021 shows development of grassland habitat, though wax myrtle resprouts (in foreground) are growing back in parts of the area. Anecdotally, and based on a very short sample, this grassland/shrub habitat appears to providing habitat for a large number of birds.

Fort Raleigh- Heritage Point Fuel Break

The Heritage Point Fuel Break lies on the Northwest tip of Roanoke Island and is the boundary of Fort Raleigh National Historic Site at the Heritage Point subdivision. The fuel break was first begun in 2011 by the Kings Mountain NMP masticator.

Following this initial mulching, the treatment became more consistent as an annual treatment by USFWS staff starting in 2018. The area treated is approximately 6 acres, with a fuel break width of approximately 20 -30 ft. Fuels along the boundary are variable, and includes thick needle case and areas of live shrub fuels.

The Southwest terminus of the fuel break ends in a maritime swamp behind structures. The adjacent type surrounding this area is mapped as Mid-Atlantic Coastal Loblolly Pine Forest, though this location has a small patch of hardwoods (**Figure 8**).



**Figure 52. Typical vegetation following spring 2021 treatment at SW terminus of the fuel break.
Photo taken in December 2021.**

In the northern part of the fuel break, the vegetation changes composition to loblolly pine mixed with drier upland species such as southern red oak, blackjack oak, and longleaf pine (**Figure 53**). This area is mapped as Atlantic Coastal Fringe Evergreen Forest (7026). The Northern section of the fuel break appears to have affinity with mainland vegetation in terms of vegetation and soil structure and is transitional in nature with true barrier island ecology and stable mainland vegetation ecology.

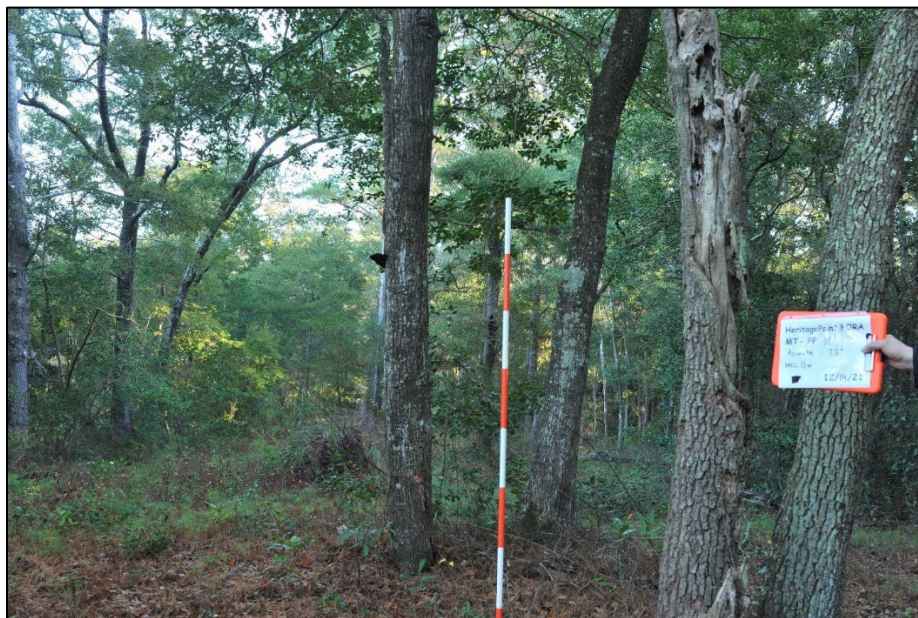


Figure 53. Photo point in northern section of Heritage Point fuel break. Photo taken December 2021.

The 2021 monitoring visit yielded a significant find of a small stand of mature long leaf pine (*Pinus palustris*) co-occurring with typical species such as Loblolly pine (*Pinus taeda*), Southern Red oak (*Quercus falcata*), Blackjack oak (blackjack oak) and sourwood (*Oxydendrum arboretum*). The area in being discussed in the middle of the northern half of the fuels treatment unit. It directly south of NPS housing and depicted, but not limited to, the purple circle in **Figure 54**.

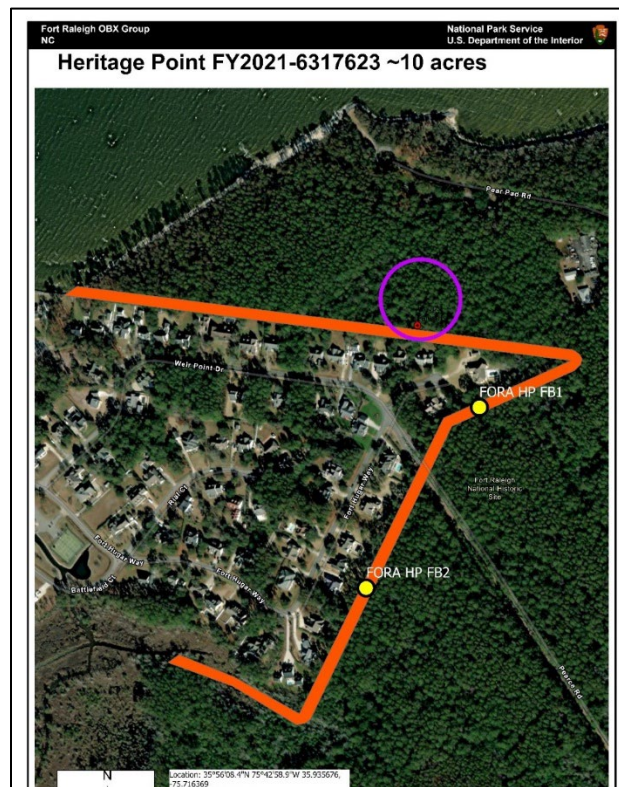


Figure 54. Heritage Point fuel break, showing location of longleaf pine stand. More scouting needs to be conducted to determine the full extent of the stand.

Although no vegetation key occurs for the Roanoke Island area of the outer banks, previous surveys and collections have taken place by various university students and Dare County Garden Club to help classify vegetation and document species. Bruce Sorrie's (former NC Natural Heritage Program botanist) abstract for the Flora of the Outer Banks states that the internal islands such as Roanoke and Harkers further south, are ecologically distinct from the true barrier islands. They are considered transitional between barrier islands and mainland vegetation because to their ability to develop deeper soils and by greater proximity to mainland types. The longleaf area example behind Park housing and adjacent to Heritage point may have been a more contiguous stand, although there is little evidence to support this following the development of the neighborhood. Photography of this stand was challenging, but **Figures 55 & 56** depict the longleaf trees in this area. Further monitoring of the extent of the longleaf occurrences around Heritage point will be a priority for APC fire effects monitoring in the coming year.



Figure 55. Longleaf pine at Fort Raleigh NHP.



Figure 56. Longleaf pine surrounded by mixed forest vegetation. No regeneration of longleaf was observed.

Wright Brothers Boundary Fuel Reduction



Figure 57. Wright Brothers NM boundary fuels treatment (red line).
The area we scouted is circled in yellow.

An updated map for Fuels Treatment of Wright Brothers National Memorial is in Figure 13. It was unclear from the visit where most of the fuels work had occurred. Follow-up visits may be helpful to determine if/when fuel treatments occurred and provide more accurate documentation.

Park staff requested that we scout the northeastern corner of the park, and advise whether it should be treated in the coming year. We were able to get out look at this area, which is a direct wildland urban-interface with limited defensible space. Fuels in this section are potentially problematic, with a bit of a fuel buildup and a patch of dead pine trees right along the community fence line (**Figures 58 & 59**). Our recommendation to treat this area with mechanical fuel reduction has already been shared with OBG staff.



Figure 58. A patch of dead pole-sized trees was observed right along the community fence line.



Figure 59. Woody fuels, thick needle cast, and live fuels along the NE boundary of WRBR near Highway 158.

Program Information: APC Zone Fire Ecology Program

Table 10. Planning - 2021

Park	Does Park have written Desired Future Conditions? (yes or no)	Date Park-level Monitoring Plan completed (or revised)	Total # of Project- or Community-level Monitoring Plans (not just 2021)	Assisted with how many BAER/BAR plans in 2021?
BISO	yes	n/a	0	0
BLRI	yes	n/a	0	0
CAHA	no	n/a	0	0
CHCH	yes	n/a	0	0
CONG	yes	n/a	0	0
COWP	no	n/a	0	0
CUGA	yes	n/a	0	0
FORA	no	n/a	0	0
GRSM	yes	50% complete	0	1
KIMO	yes	n/a	0	0
MOCR	yes	n/a	0	0
WRBR	no	n/a	0	0

n/a – no plan(s) required

Table 11. APC Zone Monitoring - 2021

Park	% 2021 Data Entered	% 2021 Data Quality Checked	# Prescribed Fires Monitored*	# Non-fire Fuels Treatments Monitored*	# Wildfires Monitored *	# BAER/BAR Treatments Monitored*
BISO	95%	0%	1	n/a	n/a	n/a
BLRI	n/a	n/a	n/a	n/a	1	n/a
CAHA	n/a	n/a	n/a	n/a	1	n/a
CONG	95%	0%	2	n/a	1	n/a
FORA	95%	0%	n/a	1	n/a	n/a
GRSM	95%	0%	3	2	1	n/a
KIMO	95%	0%	2	1	n/a	n/a
MOCR	95%	0%	4	n/a	n/a	n/a
WRBR	n/a	n/a	n/a	1	n/a	n/a

** Number of treatment units with treatment effects monitoring conducted. Include pre-burn and post-burn monitoring but not burn-day monitoring. n/a – no data collected or no monitoring required*

Table 12. Communicating Results - 2021

Park	# of Project Monitoring Reports completed in 2021	# of Annual meeting(s) with Park staff	# of Formal presentations of results	Do you use Minitab?
BISO	2	1	0	yes
BLRI	0	0	0	yes
CAHA	1	1	0	yes
CHCH	0	0	0	yes
CONG	1	1	1 / Annual Report	yes
COWP	0	0	0	no
CUGA	1	0	0	yes
FORA	1	1	0	n/a
GRSM	4	3	2	yes
KIMO	1	2	0	yes
MOCR	1	1	0	n/a
WRBR	1	1	0	n/a

** This information will help to assess Minitab multi-user license needs. n/a – no new data to report/present*

Fire Ecologist Accomplishments and Areas of Focus

Table 13. Fire Ecologist 2021 Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	30%	Substantial work on APC Zone FMP updates (multiple parks); GRSM Monitoring Plan; fire effects program planning; fuels project planning for GRSM, MOCR, KIMO, CHAT, CONG; meetings; GRSM IDT
Supervision/Admin	20%	Supervision, Performance evaluations, Training, IDPs, travel, payroll, crew support, purchasing etc.
Data Collection	15%	Field monitoring at GRSM, MOCR, CONG, KIMO, CAHA, FORA, WRBR; collaborative work at CHAT with SECN I&M Program
Data Management and Analysis	10%	Routine data management tasks; Fire records; GIS data; Analyses completed for 2020 Annual Report and several presentations
Fire Operations	5%	RX burns at GRSM, CONG, KIMO; ignitions and FEMO
Research	5%	Reviewing papers; Agreements for funding; communication/coordination; park orientation; assist with proposals
Presentations	5%	Building powerpoints; preparation; Climate/Fire Panel; APC Zone Fuels crew; GRSM IDT: AFE
Reports	5%	Annual report; FEMO reports
Misc	5%	National BAER Team calls; providing training; updating WIMS with new NFDRS; RAWs maintenance; BAR support; NPS Fire/Climate work group

Fire Effects Crew Accomplishments and Areas of Focus

Table 14. Fire Effects Crew 2021 Accomplishments/Focus Areas

Category	Percent Time	Notes
FMH plots	10%	Limited FMH plot data collection
WUI plots	5%	Mechanical treatment monitoring
Other plot work	10%	LFEM plots at GRSM, MOCR, KIMO, CONG, and OBX group
Detail	25%	Lead monitor detail to Southeast Coastal I&M network for long-term plot installation at CONG and CHAT
Wildfire assignments	10%	Lead Monitor- REAF assignments on Mcfarland and Dixie Fire
Prescribed fire projects	10%	Lead and Assistant- FEMO/FFT1/FFT2 on Rx burns : Cades Cove, Wear Cove Gap, KIMO, CONG, USFS-Cherokee
Non-fire fuels projects	5%	Various technical support
Travel out-of-park for plot or project work	10%	Lead and Assistant travel to KIMO, CONG, OBX-group, CHAT, and MOCR
Data entry	2%	Data mostly digital collection
Supervision/Admin	3%	Time/Travel/Budgeting
Training	2%	RT-130 Refreshers, Required NPS training, Lead- Prepare for instructing N-9042 Read training in 2022
Miscellaneous	3%	Lead assigned to purchase mobile radio for Fire Management Assistant help prepare Monitoring Plan for GRSM

Appendix A. Workforce Transformation Supplement

The DOI wildland fire workforce transformation strategy and the NPS Wildland Fire Strategic Plan (2020 – 2024) have increased the funding available for wildland fire positions throughout DOI and NPS. The intent of this supplement is to capture the benefits of those initiatives to the NPS fire ecology program and to the wildland fire program as a whole. Please answer the following questions related to regional, national, and departmental workforce transformation efforts.

- Did your fire ecology program receive additional funding for new positions and/or extended seasons this year? **NO.**