



Southern Appalachian/Piedmont Fire Effects Monitoring Annual Report, 2016



On the Cover:

The rugged landscape of the Chimneys obscures the first Chimney Tops wildfire on November 13, 2016. Two weeks later, the nearby Chimney Tops 2 wildfire would become the largest wildfire in the history of Great Smoky Mountains National Park.

Southern Appalachian/Piedmont Fire Effects Monitoring Annual Report, 2016

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Introduction

For the remainder of our careers and beyond, 2016 will be remembered foremost for the tragic events that occurred on November 28. In a single day, a complex of wildfires burned over 17,000 acres of public and private land in and around Great Smoky Mountains National Park. Winds estimated to have been over 100 miles per hour drove fire across natural communities that have not seen fire in over a century, and through human communities that could not have imagined such a sudden, catastrophic event. In the end, 14 people perished as a result of the fires, and many more were injured. Over 14,000 people were successfully evacuated, but more than 2,400 structures had been damaged or destroyed. There hasn't been sufficient time to put this event into the proper context, but it will clearly go down in history as one of the most extreme and tragic fires in the history of the country.

One important piece of the overall context will be the extraordinary drought and long fire season throughout the Southern Appalachian-Piedmont Fire Management Zone (FMZ) during 2016. Close-to-normal levels of rainfall during the late winter and spring allowed completion of numerous prescribed burns that achieved important fuels-reduction and landscape restoration goals (**Table 2**). The season started with a successful multi-agency prescribed burn at Air Bellows Gap on the Blue Ridge Parkway. This burn marked an important step for cooperative landscape burning across multiple jurisdictions in the Southern Appalachians. Other highlights included a fourth-entry burn of the Saddleback burn unit at Kings Mountain (KIMO), and third-entry burns of Arbutus Ridge in GRSM, Dark Ridge C in Cumberland Gap (CUGA), and Divide Road at Big South Fork (BISO). Congaree National Park (CONG) completed another successful burn of the longleaf pine stands in the RCW/Harry Hampton burn unit, and a 100-acre mechanical fuel reduction project at the park boundary near the Harry Hampton Visitor Center.

Wildfires also occurred in the spring, most notably the Gladys Branch fire that burned 240 acres on the north shore of Fontana Lake at GRSM during April. What would become a persistent and extreme drought began shortly after the Gladys Branch fire, with the monthly rainfall deficits exacerbated by some of the hottest growing-season temperatures on record. The effects of the drought first became evident during the Crawfish Branch fire that occurred on the northern boundary of GRSM in early July. This was the first in a season of wildfires that exhibited long smoldering in deep duff and a stubborn resistance to control.

The pronounced summer drought contributed to additional persistent fires at Great Smokies, on Lookout Mountain at Chattanooga Battlefield (CHCH), and on newly acquired lands of the Blue Ridge Parkway (BLRI). The Plott Balsam wildfire at BLRI was particularly noteworthy because of its elevation, the unusual heath/duff fuel type, and the weather patterns that contributed to its persistence. This wildfire is briefly discussed in the BLRI section of this report.

As summer turned to fall, the strong regional drought and fresh falling leaves created a high level of fire danger that was highlighted in an October 10 Fire Risk Assessment issued by the Southern Area Coordination Center. Between October 20 and November 27, FMZ fire staff provided 7-day coverage and collectively responded to at least 14 separate fires on GRSM lands, BLRI lands, Cherokee BIA lands, and private/state lands. Additional fires that required some coordination occurred at CHCH, Little River (LIRI), and BISO during this same time period.

The fall fire season culminated in the events of November 28. *The next day, a season-ending pattern of normal seasonal rainfall had begun throughout much of the drought-stricken area.*

Amidst all the wildfire response and firefighting of 2016, and with two unfilled positions (**Table 3**), the Appalachian-Piedmont fire effects team still managed to collect a tremendous amount of data (**Table 1**), continue the process of transitioning to electronic data collection, and provide strong support to other NPS fire effects programs. Major accomplishments for the year included year-1 monitoring at BLRI using a new protocol for fire effects mapping, immediate post-burn monitoring of all burned plots, and long-term monitoring and severity mapping at GRSM, BLRI, CUGA, KIMO, BISO, and CONG. Perhaps the highlight of the field season was a highly successful week-long trip to Shenandoah NP to assist the Northeast Region monitoring team with severity mapping of the 10,000 acre Rocky Mountain wildfire.



Burn severity pattern of the 2016 Rocky Mountain Wildfire at SHEN. GRSM Ecologist and Fire Effects Crew provided CBI training and helped complete a solid week of CBI plotwork in 2016.

**Table 1. Appalachian/Piedmont Fire Effects Monitoring Program:
2016 Plot Workload and Total Plots Installed**

Park	Monitoring Unit	Plot Type	Pre-burn 2016	Immed. Post 2016	Postburn (1-20 yrs) 2016	Annual Total (2016)	Total Plots
Big South Fork (BISO)	Little Bluestem	FMH Forest Plot			1	1	4
	Shortleaf Pine	FMH Forest Plot		1	1	2	2
	White Oak	FMH Forest Plot		1	2	3	13
	LFEM	Modified FIREMON Species Composition			5	5	17
	CBI	CBI				0	9
	Fuels Transect	Fuels Transect				0	4
Blue Ridge Parkway (BLRI)	Chestnut Oak	FMH Forest Plot				0	2
	LFEM	Modified FIREMON Species Composition	7		7	7	7
	Fuels Transects	Fuel Transect				0	6
	Photo Points	Photo Point				0	2
Cape Hatteras (CAHA)	LFEM	Modified FIREMON Species Composition				0	15
	Photo Points	Photo Point				0	33
Congaree (CONG)	Loblolly Pine	FMH Forest Plot		3	3	3	5
	Longleaf Pine	FMH Forest Plot		5	5	5	5
	Harry Hampton Mastication (LFEM)	Modified FIREMON Species Composition	17	17		17	17
Cowpens (COWP)	Southern Red Oak	FMH Forest Plot				0	2
Cumberland Gap (CUGA)	Scarlet Oak	FMH Forest Plot		2	2	4	16
	LFEM	Modified FIREMON Species Composition			3	3	10
Great Smoky Mountains (GRSM)	Black Oak	FMH Forest Plot					8
	Scarlet Oak	FMH Forest Plot		1	2	3	16
	Yellow Pine	FMH Forest Plot		1	6	7	40
	LFEM	Modified FIREMON Species Composition	3		4	7	36
	CBI					0	70
	Fuels Transect	Fuels Transect				0	7
Kings Mountain (KIMO)	Blackjack Oak	FMH Forest Plot		2	2	4	8
	Chestnut Oak	FMH Forest Plot		5	5	10	21
	LFEM	Modified FIREMON Species Composition				0	18
	Fuels Transect	Fuels Transect				0	3
Moore's Creek (MOCR)	Photo Points	Photo Point		2		2	2
Total			27	40	48	83	398

Table 2. Summary of 2016 Prescribed Burns and Monitoring

Park	Burn Unit	Plots?	Other Monitoring	Acres
Big South Fork (BISO)	Divide Road	Yes (Full Plots)	Yes (Qualitative, LFEM and FEMO)	499
Blue Ridge Parkway (BLRI)	Air Bellows	No	Yes (LFEM and FEMO)	431
Congaree National Monument (CONG)	RCW/Harry Hampton	Yes (Full Plots)	Yes (LFEM)	450
Cumberland Gap (CUGA)	Dark Ridge C	Yes (Full Plots)	Yes (FEMO, LFEM)	500
Great Smoky Mountains (GRSM)	SE Arbutus Ridge	Yes (Full Plots)	No	398
	Sparks	No	Yes (FEMO)	240
	Cable Mill	No	Yes (FEMO)	90
	Cemetery Marsh	No	Yes (FEMO)	87
	Methodist/Primitive Baptist	No	Yes (FEMO)	420
Kings Mountain (KIMO)	Saddleback	Yes (Full Plots)	Yes (FEMO, Qualitative)	406
Total	11	19	36	3521

Table 3. Fire Ecology/Fire Effects Staffing 2016

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	READ Qualified (Yes or No)	Training and Development
Rob Klein (Fire Ecologist)	1/1/16	12/31/16	26	Yes	
Wylie Paxton (Lead Monitor)	1/1/16	12/31/16	26	Yes	
Matt Wood (Assistant Lead)	1/1/16	12/31/16	26	No	
Vacant (STF Crewmember)					Expect to fill in FY17
Vacant (Seasonal Crewmember)					Expect to fill in FY17

Big South Fork National River and Recreation Area (BISO): 2016 Fire Effects Monitoring Annual Report

BISO Fire Summaries

Five Fires occurred at the Big South Fork including the management ignited prescribed fire at Divide Road. The significant fires for the park are highlighted below.

<i>Name</i>	<i>Date</i>	<i>Size</i>
TP WF	4/4/2016	1.5
Divide Road South Rx	4/5/2016	500
Camp Branch WF	4/22/2016	80
Chimney Rock	11/18/2016	603
Low Cut	11/22/2016	4.3

Divide Road South Prescribed Fire - 500 acres on 4/5/2016

The 2016 prescribed burn of Divide Road was the third entry of fire into this burn unit since 2006. For this burn, the Divide Road unit was separated into two sections: “North” and “South” of the Middle Creek Road (trail). This year’s burn was of the South unit. With a complex landscape and heavy fuel loading, Park Resource staff prudently decided to separate them and focus the Southern half. The vegetation is essentially mixed white oak-scarlet oak with hickory and other hardwoods. Small scatterings of shortleaf pine remain in the protected areas where they weren’t affected by previous southern pine beetle outbreaks.

Former southern pine beetle sites on ridgetops and high burn-severity patches from previous fires are currently hardwood resprout thickets, as seen in the photos below. These areas are in various stages of restoration towards woodland conditions, and require repeated frequent burning to continue in a favorable trajectory.

Weather Conditions for the burn featured light winds out of the north, temperatures in the 40-mid 50’s°, and the low relative humidity was 25 % (1500-1700).

Fire Behavior and Effects

The fire behavior at the beginning of the burn was a light backing fire with good consumption of fine fuels. As the burn progressed, fire behavior became more active, and several instances of moderate intensity were observed. This behavior was partly the result of the complex terrain within the unit, partly fuel exposure due to effects from previous burns, and partly due to the timing of ignition/ignition sequence. Concern with local smoke impacts was a major factor that drove the pace of the burn more quickly, and reduced the ability of the burn crew to control fire intensity. The burn provided good coverage and results given the smoke constraints, complex terrain, and heavy fuel loading/fuel exposure. The firing boss and ignition squads worked diligently to limit any further overstory mortality, and produced what was overall an effective and interesting burn.

Excellent consumption of litter and fine fuels resulted in a light burn for the majority of the unit. Some flanking fires throughout the hardwood thicket areas produced a more moderate severity depicted in the Severity map of Figures 2 below and the photo Figure 1. Additional moderate severity may have occurred in mature oak forest at the northeast and east-central part of the fire.



Figure 1. Fire moving through Hardwood re-sprout area

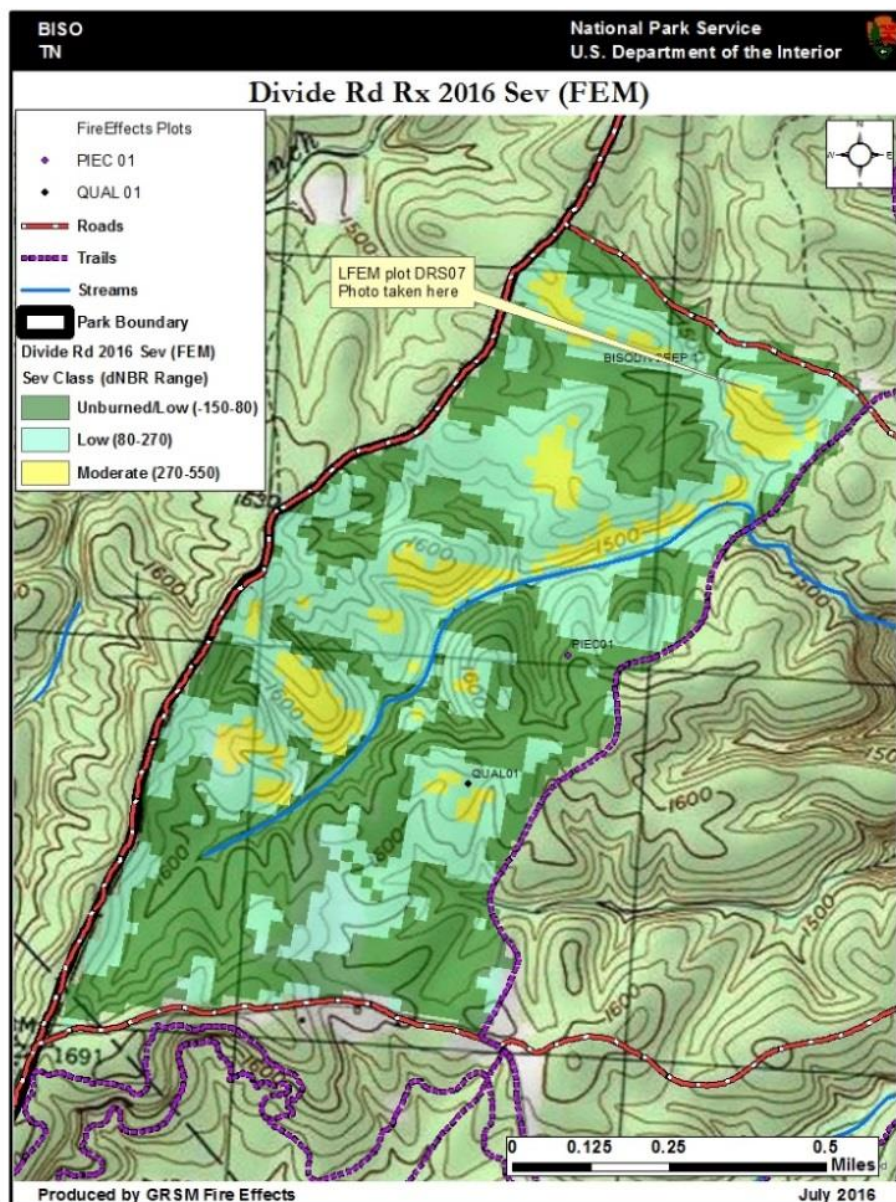


Figure 2. dNBR Extended Burn Severity Map

LFEM Plot DRS 07 03y01 depicted in North-East corner of Figure 2 illustrates good top-kill on hardwood resprouts. This photo also illustrates surviving Shortleaf pine regeneration becoming established on the site. These are both important goals for Divide Road restoration.



Figures 3-5 below depict fire effects in Plot QUAL 01 from 2006 (1 growing season following the first and burn , then the fifth year following the second burn and lastly 1 year growing season following the third burn)



Significant mortality on poles from first burn as well as major scarring of overstory oaks

Figure 2. QUAL 01 01yr01 (2006)

Following overstory mortality induced by the first two burns, hardwood re-sprouts in the understory are released to form dense thickets.



Figure 3. QUAL 01 02yr05(2012)

The 2016 burn covered the area well and top-killed hardwood re-sprouts. This was a crucial objective of this year's burn, and these results should improve conditions for shortleaf pine, herbs, and oak regeneration. Further treatments are necessary to continue the restoration process.



Figure 4. QUAL 01 03yr01 (2016)

Chimney Rock WF – 534 acres on 11/18/2016

A human caused wildfire in the Tennessee portion of the park. It occurred off Station Camp road which is almost in the center of the park and along the East side well within NPS boundary. The fire was discovered on 11/18, and on 11/19 the Mississippi zone was briefed on the situation. The type 3 Incident Management team was in place on 11/22. Until Mississippi zone staff could assume command some other operations were put in place by the USFS Type-2 team, but it is unclear what happened. With extreme drought conditions being a factor and steepness of terrain, holding became difficult and several larger slopovers occurred. An initial observation that constant smoldering and complete consumption of fine fuels which produced white ash in soil - indicative of fire during extreme drought conditions. The fire was contained mostly by using hand lines, roads, a dozer line and burning out.

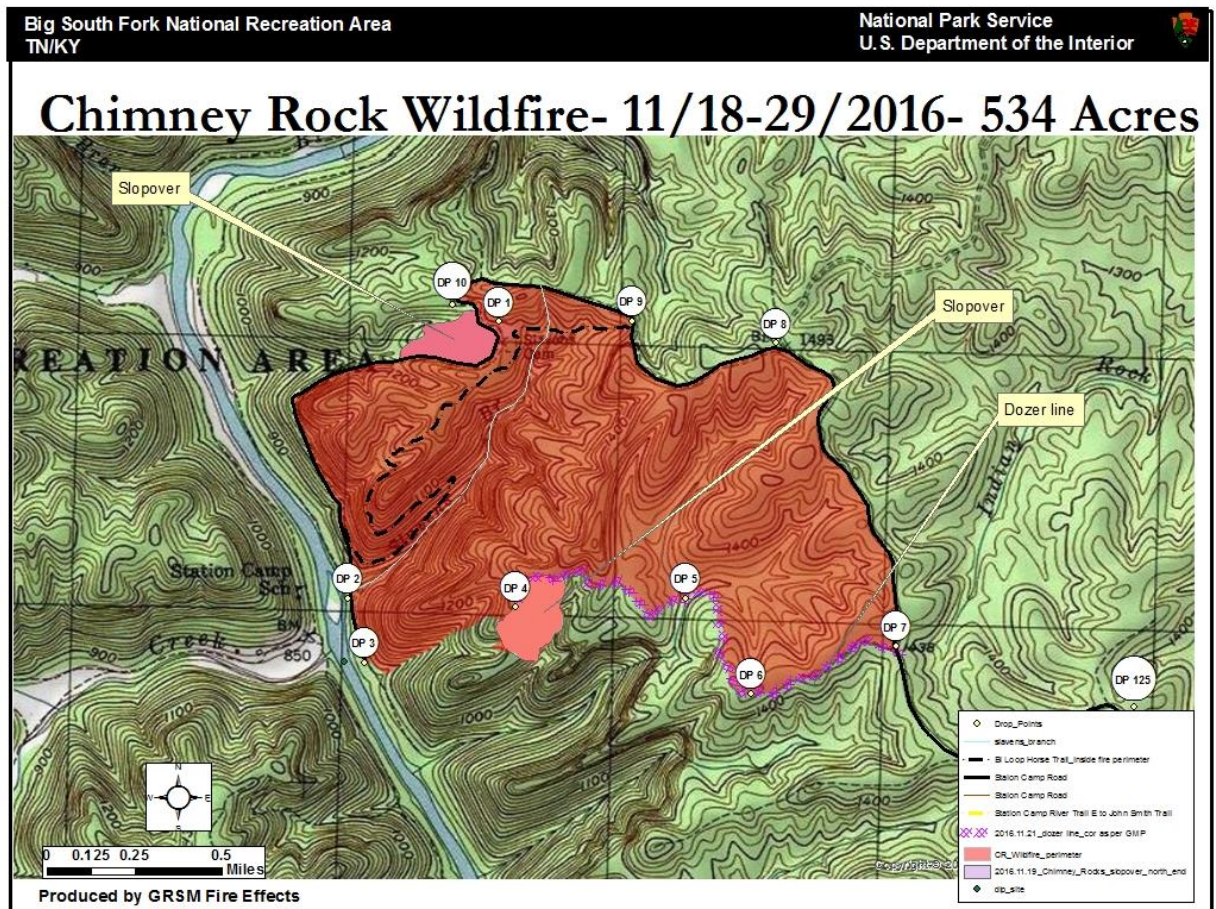
Prior to the wildfire, the site included mostly second-third growth forest. Vegetation is typical of the oak-hickory and mixed mesophytic forests of the Cumberland Plateau, with the majority of vegetation within the burned being mesic oak-hickory, and drainages with more protected species such as Beech, Northern Red Oak, Hemlock, tulip poplar, magnolia and sassafras. Rich herbaceous diversity occurs throughout this area. The xeric ridgetops with sandstone caps are typical dry oak species with Virginia pine.

Several Park Cultural and Natural resources were impacted due to suppression and details can be found in the BAER plan. Most of the impacts occurred due to line construction with a dozer on south side of the fire and impacts due to the severity of the fire.

Resource Advisors were deployed during Initial attack and rehab operations of the fire and provided good intelligence to the Incident Command and to the park. Further work to prevent resource damage on future wildfires may include development of a *Wildland Fire Incident Resource Protection manual* or *Turn-back standard* to hand over to incoming Incident Commanders for briefing of Resources at risk to Suppression and Park Standards. Lastly, a request for severity image has been placed to inform future monitoring and resource concerns. NPS fire-effects crews will be on-site doing severity monitoring in the coming year.



Figure 5. Burnout operations during control of Chimney Rocks WF



Long Term Monitoring Results

There are no new data to add to the long-term monitoring results. The most up-to-date analysis of monitoring results is provided in **Table 1**.

Table 1. Objectives and long-term monitoring results for BISO

Vegetation Type	Management Objective Restoration Phase- (After 4 burns)	Monitoring Results (80% confidence intervals)	Objective Achieved?	Year Last Analysis Completed
Dry Oak Forest (FQUAL1) 14 plots	>50% Reduction in total fuel loading	Total fuel reduction After one burn = 52% ($\pm 2\%$) ($n=10$ plots)	Yes, but will require more time to assess.	2012
	>70% Reduction in pole-sized tree density (≤ 15 cm dbh)	Pole reduction After one burn = 58% ($\pm 7\%$) ($n=10$ plots)	Not yet, but on course.	2012
	20-40% Reduction in overstory tree density (> 15 cm dbh)	Overstory reduction After one burn = 4% ($\pm 2\%$) ($n=11$ plots)	Not yet, but this is a long-term objective	2012
	>200 tall (> 1 m) Oak seedlings /ac	Preburn mean: 96/acre (± 43) Post-burn mean: 103/acre (± 35) ($n=11$ plots)	Not after a single burn.	2012
	>30% Cover by native herbs	After 1 burn: 14% (± 5) ($n=11$ plots)	Not after a single burn.	2012
Little Bluestem Sandstone Glade/Savanna (FSCSC1) 3 plots	>70% Reduction in pole-sized tree density	Pole reduction: After one burn = 16% ($\pm 11\%$) After two burns = 30% ($\pm 14\%$) ($n=3$ plots)	Not yet, but on course.	2011
	>100% Cover by native herbs	Preburn cover: 98% (± 26) After 1 burn: 123% (± 28) After 2 burns: 133% (30) ($n= 3$ plots)	Yes, but not with 80% confidence	2011

Note: Underscored sample size indicates that minimum plot numbers exist for $\alpha = 0.20$

Blue Ridge Parkway (BLRI): 2016 Fire Effects Monitoring Annual Report

Like many places in the Southern Appalachians during 2016, Blue Ridge Parkway was affected by a season-long severe drought and numerous human-caused ignitions. After a highly successful multi-agency prescribed burn at Air Bellows Gap (NC) in early March, the Parkway experienced at least 15 wildfires (*see Table below*). Those fires were all suppressed by park staff, local cooperators, or staff of the Appalachian-Piedmont Fire Management Zone based out of Great Smoky Mountains National Park. Several of these fires are discussed below.

Fire Name	Size	Approximate date
Air Bellows RX	431	3/9/2016 <i>(prescribed burn)</i>
Standing Rock WF	.5	3/18/2016
MP 68	1.2	3/26/2016
MP 65.5	.1	3/26/2016
Grassy Branch WF	.1	4/4/2016
Shope Creek WF	84 (8.2 on NPS)	4/17/2016
Linn Cover Viaduct WF	.2	4/19/2016
Route 610 WF	?	4/19/2016
Lightning 89	.1	8/17/2016
Beacon Heights WF	.1	10/10/2016
Mile Marker 465	.5	11/2/2016
Plot Balsam Overlook WF	47	11/2/2016
Jenkins Ridge WF	10~	11/2/2016
Saunook WF	.3	11/6/2016
Humpback WF	?	11/12/2016

Air Bellows Collaborative Prescribed Fire -431 combined acres of North Carolina State Parks, North Carolina Wildlife Commission and National Park Service 3/9/2016

The first collaborative burn for the Blue Ridge Parkway and the Appalachian Zone Fire Management, in which NPS staff played a minor role in planning and overhead for the burn but worked in unified operations with NC Wildlife Resources Commission and NC State Parks. The NPS staff worked almost independently alongside Wildlife commission Burn Boss Dean Simon and crews from State Parks, especially when it entailed NPS land.

Weather conditions: The Rx unit lives up to its name of Air Bellows. Winds were gusty along the parkway for the 2 days of burning and helped fire move around, even where fuels were more compact. Highest gusts were recorded on day 1 at 1330 with sustained winds 12-13(17 gusts). Some snow existed on shaded slopes, but had mostly melted from the South and West facing ridges which were the target communities of the burn. The temperatures were in low 60's for the majority of the burn area and low humidity's only reaching 52% at 1630.

Good coverage of the burn was achieved on NPS land due to firing personnel taking initiative to fire interior ridges simultaneously. The pine/oak communities of the west side could have used more fire intensity but holding concerns and heavy smoke along the midslope road made effective firing difficult.

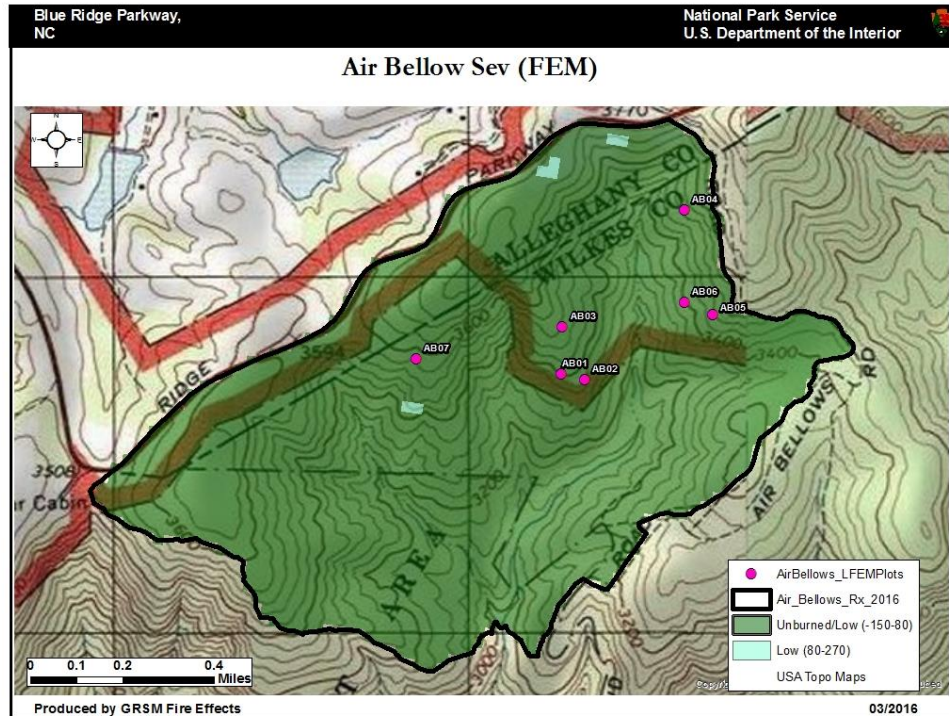
Some firing happened on Day 2, but this was done by NCWRC staff on the Northeast corner to create a bigger buffer where there were unburned fuels along the line. Fire did not move far from the edge of the ignition line on this day and fire progression ceased.



Typical fire behavior on oak-dominated ridgetops



Fire backing off prominent North-south ridge and typical flame height and intensity



Burn severity mapping (dnBR) revealed a low severity burn, which was the goal for this first-entry of fire

Although severity was classified as “low-unburned” with the satellite imagery, the majority of the unit burned, oftentimes with notable severity in the understory. Seven long-term monitoring plots were installed in 2015 and resampled following the burn. All of the plots burned, and the photo series below depicts the strong understory effects in Plot 01. These types of effects were observed in several of the plots. A more complete analysis of the monitoring data will be completed in 2017.

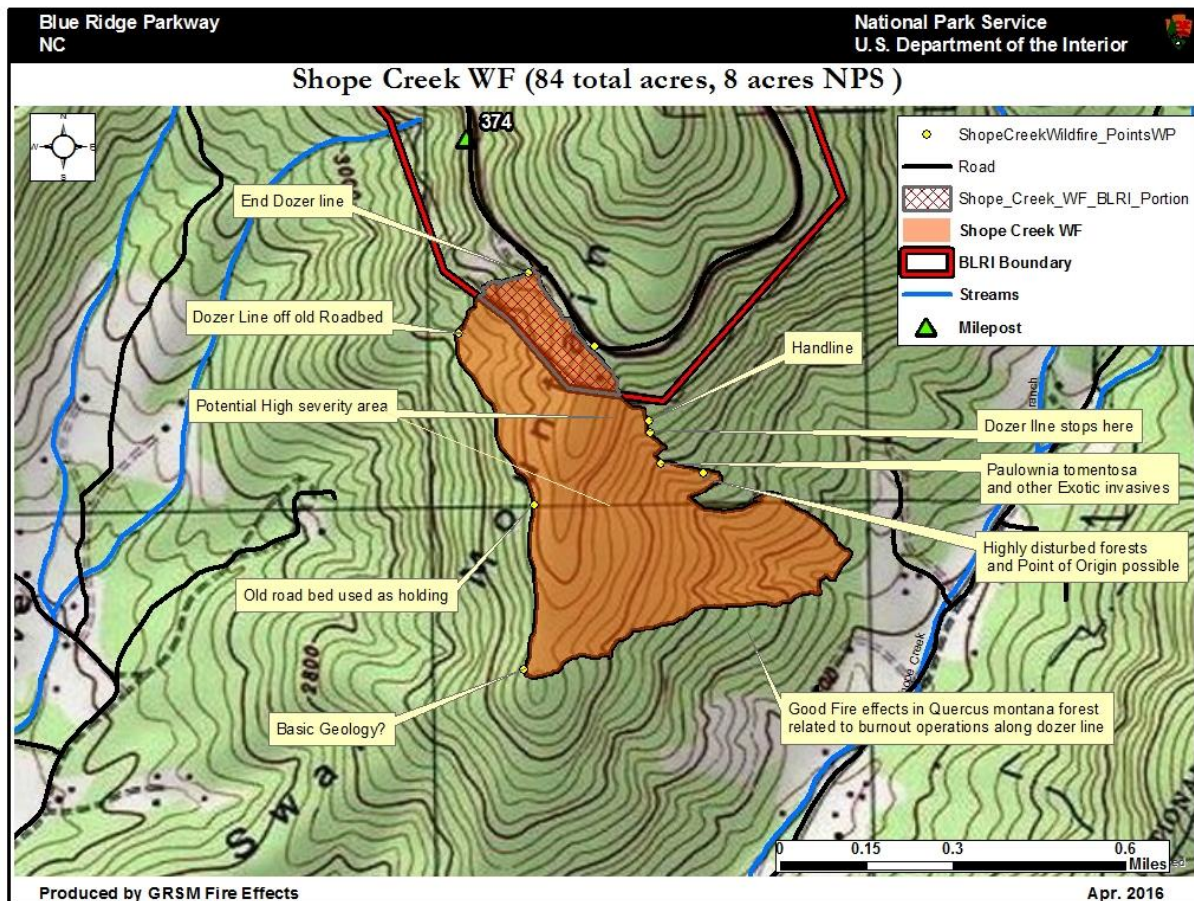


Figure 2: Air Bellows 01 - Preburn



Figure 3: Air Bellows 01 - Year 1 Postburn

Shope Creek Wildfire - 84(8.4 NPS) acres on 4/8/2016



Shope Creek area is recorded, at least the upper portion, as a Natural Heritage Community Type global/ local ranking G3. The area had one avian species of potential concern found in a 2012 survey within the confines of the burned area. This fire occurred primarily on USFS land, but included 8 acres of Blue Ridge Parkway land. In the distant past, portions of this area had controversial logging-related issues between the US. Forest Service and local community groups.

The whole Shope Creek Fire experienced a mix of severity. The Northern Hardwood and Montane Oak Hickory (basic) forest portion directly above the possible point of ignition all the way to the ridgetop appeared to have experienced moderate to high severity. dNBR or other reflectance imagery could be collected to assess the accuracy of this statement.

Overstory mortality is likely to be high on the upper slopes and Shope Creek side of the fire and East facing side of Swan Mountain. (See comments on Map). Invasion of exotic plant species should be scouted if concerned with impact to vegetation cover change.



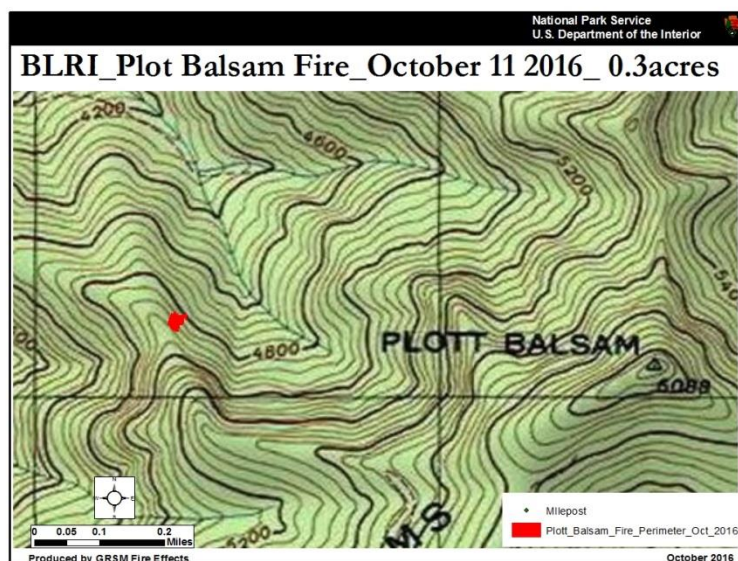
Char and potential impacts to overstory and observed litter/duff removal (labeled on map as “potential high severity area”

South boundary and spur ridge of the fire had great fire effects on the shrub vegetation (dominated by *Kalmia latifolia*) and limited effects on the dry-mesic oak overstory although no picture is available. Some parts of the richer forests areas and impacts looked as if incomplete burning occurred (see photo below).



Dozer line around 95% of the fire line probably only impacted the steepest slopes as far as hydrology and invasion of exotics are concerned. No dozer line has been rehabbed on this fire to date. NPS land had minimal soil compaction due to dozer allowed to tram across boundary

Plott Balsam Wildfire - 0.3 acres on 10/10-15/2016



A human-caused fire occurred on October 10, 2016 on newly acquired Blue Ridge Parkway land on Plott Balsam Mountain. The vegetation community where the fire occurred is a complicated mix of groups comprised of at least two: Red Spruce - (Yellow Birch, Yellow Buckeye) / (Great Laurel, Catawba Rosebay) Forest and Southern Appalachian Acidic Mixed Hardwood Forest . Notably, this fire occurred directly downslope of a significant heath bald, and the vegetation was an ecotone between the heath bald and the forest types listed above. The key component of the fire that was burning was the thick duff layer as seen in the photo below.

Nighttime inversions remained in place during the first few days of the fire, which resulted in exceptionally low overnight relative humidity (see highlights in Table below). This phenomenon was not indicated in the Spot forecasts obtained for the fire, though they were a significant factor that combined with the regional drought to allow the duff to smolder all night long.

FORMATTED DATE-TIME	Temperature	Relative Humidity
10/11/2016 13:00	81	28.9 (arrival on fire)
10/12/2016 1:30	49.4	50.5
10/12/2016 3:30	50	18.1
10/12/2016 7:00	54.1	7.5
10/12/2016 10:00	52.3	15.4
10/12/2016 14:00	57.4	41.4
10/12/2016 22:30	52	31.1
10/13/2016 0:00	54.4	17.2
10/13/2016 2:00	54.6	18
10/13/2016 6:00	54.5	18.6
10/14/2016 10:30	54.3	66.7
10/14/2016 0:30	52.8	81.1



Photo pair showing the depth of the duff along the control line prior to burning and after burning.

The fire tools illustrate both the extraordinary duff depth (over 18”) and the near complete consumption of the duff that was observed on this fire and several others in 2016.





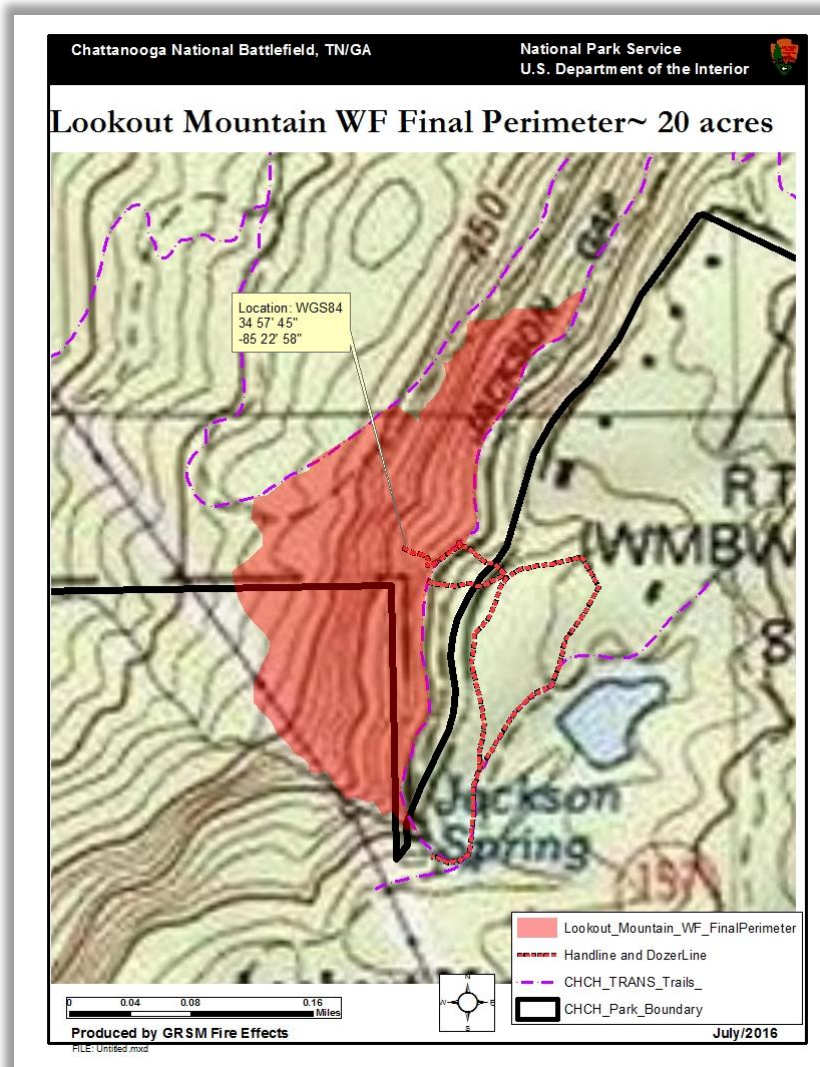
Some evidence (charcoal) of former fire at the site was discovered during hand-line construction. Multiple fragments were observed buried about a foot deep in the thick duff of the shrubland community.

Cape Hatteras National Seashore (CAHA): 2016 Fire Effects Monitoring Annual Report

The leadership staff of the Appalachian-Piedmont Fire Management Zone visited CAHA in June of 2016. During consultation with CAHA leadership and local cooperators, it was agreed that broadcast burning of the Bodie Island burn units would be put on hold pending further planning and development of clear objectives. It was decided to proceed with mechanical fuels-breaks at the South Nags Head WUI and Ocracoke Village, though those projects were not completed in 2016. In the absence of any planned broadcast burning or mechanical fuels-reduction projects, the Appalachian-Piedmont fire-effects monitoring team did not make a trip to CAHA in 2016.

Chickamauga/Chattanooga National Military Park (CHCH): 2016 Fire Effects Monitoring Annual Report

2016 was the first year that the Appalachian/Piedmont fire ecologist and fire-effects team became engaged in the CHCH fire program. Most of last year's support involved the participation of the fire ecologist in the development of a new Fire Management Plan. Other important work to support CHCH included work done on the Lookout Mountain Wildfire, creation of a fuels map, and engagement with NPS and non-NPS scientists on the need for fire in the calcareous glades of Chickamauga Battlefield. This year's report is simply a quick overview of the year's wildfires. Future monitoring and reporting will be contingent on the implementation of the park's new 5-year fuels treatment plan.



Map of Lookout Mountain Wildfire showing dozer line and Jackson Gap Trail



Nursing the top of the fire along Jackson Gap Trail



Fire extinguished by more protected, shaded vegetation along the edge of Jackson Springs Creek



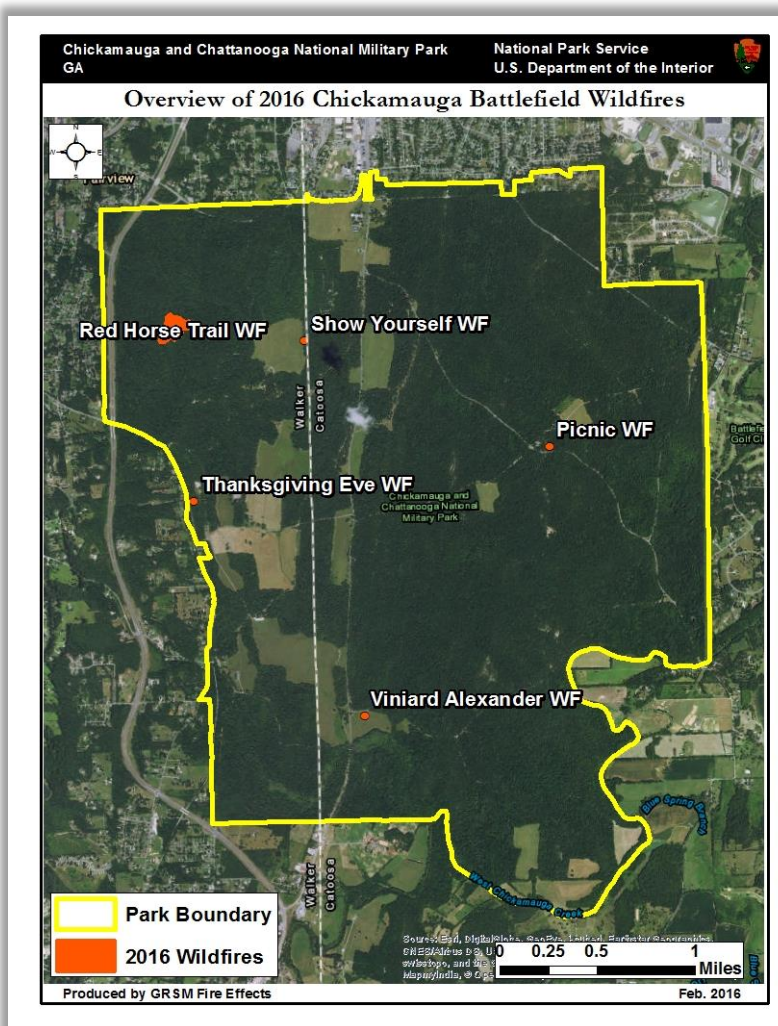
Typical immediate post burn severity observed on convex slopes, ~ 1m average char height, heavy scorch from understory to overstory, and heavy duff consumption



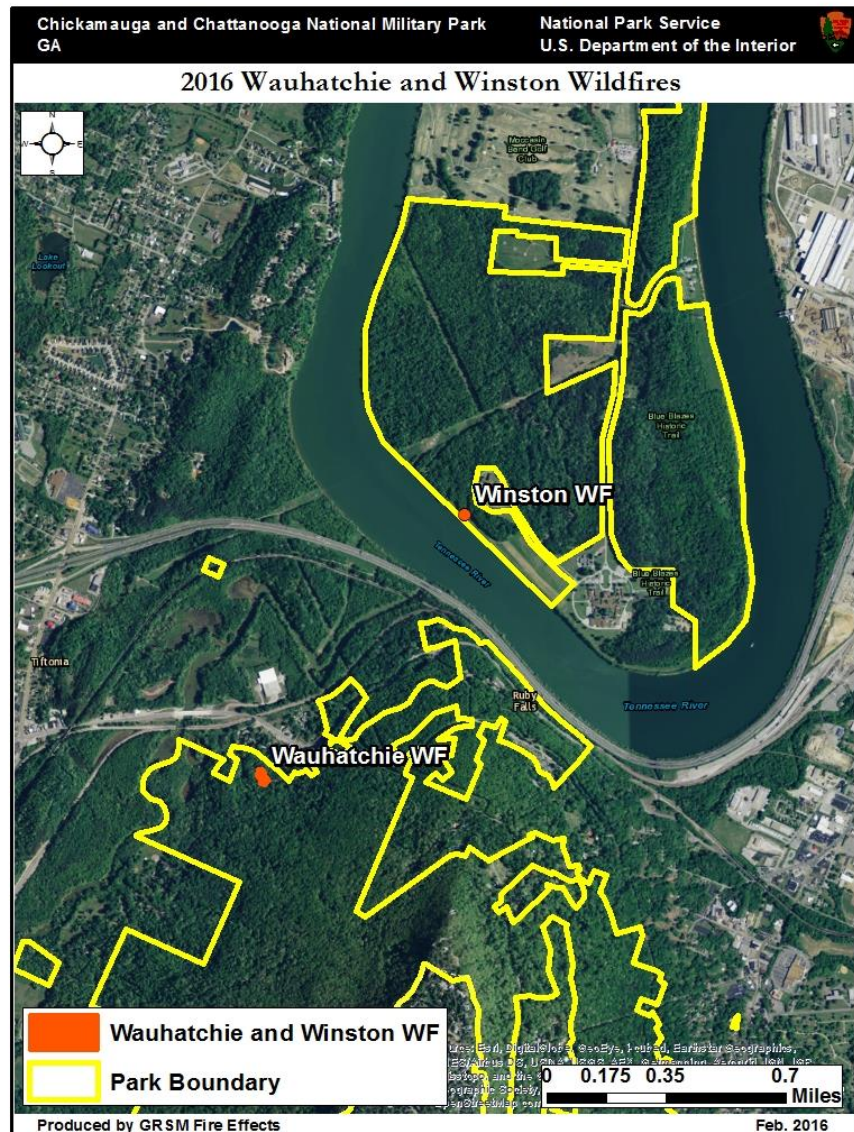
Dozer impacts in Jackson Spring Creek crossing was the primary rehab concern

Other 2016 CHCH Wildfires

Fire Name	Discovery Date	Final Acreage
Lookout Mountain WF	7/11/2016	19.9
Viniard Alexander WF	10/13/2016	0.5
Picnic WF	10/24/2016	0.1
Red Horse Trail WF	11/2/2016	8.1
Winston WF	11/3/2016	0.2
Show Yourself WF	11/6/2016	0.1
Wauhatchie WF	11/15/2016	0.7
Thanksgiving Eve WF	11/23/2016	0.1



Overview of 2016 CHCH wildfires occurring within the Chickamauga Battlefield portion of the park



2016 CHCH wildfires around northern Lookout Mountain and Moccasin Bend

Congaree National Park (CONG): 2016 Fire Effects Monitoring Annual Report

2016 Congaree National Park Fires Summary:

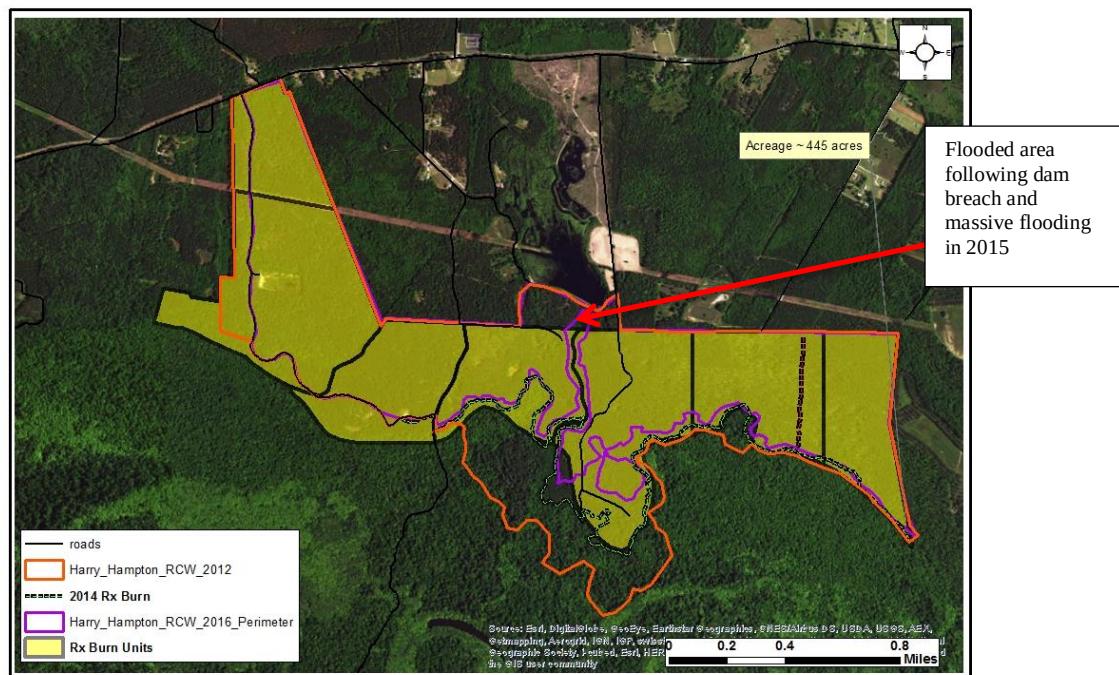
For 2016, CONG experienced 2 fires with one being a typical prescribed fire in the Harry Hampton/ RCW units, and the other a lightning strike in the beginning of the summer near their newly replaced boardwalk.

RCW/Harry Hampton Prescribed Burn - (500acres)- 4/19/2016

With limited resources to meet Burn Plan minimums, South Carolina State Forestry supplied holding resources for the day. Weather appeared to be a factor with fire spread, and as can be seen from the map below, fire spread was similar to that observed under “typical” conditions of past burns, but less than that observed during the dry years of 2012 and 2014.

One change to burning this year was due to the massive flooding that occurred in 2015. During that event, a dam broke on private land north of the unit and flooded the unit (see map below). This actually ended up being helpful for operations because it made it possible to divide the two units up and fire them separately without holding concerns.

RCW Floodplain Rx Fire Extent: 2012 vs. 2014 vs. 2016



Overall, the burn was pretty light, but was effective at top-killing sweet gum stems $< 1''$ in diameter. The following photo series illustrate the effects of the 2016 burn, and also illustrate the “escape” of larger sweet gum saplings in some parts of the RCW burn unit.

Fire Effects Plots within 2 units:

RCW plots – Due to time constraints and a heavy wildfire load during 2016, no 09Post-burn reads were done and only photos were collected as 09yr1 data.

2014: the eighth burn of this site top-killed sweet gum stems $< 6'$ in height.



PIPA02 08yr01 (June 2014)

2016 : the ninth burn of this site resulted in good top-kill of sweet gum sprouts from the 2014 burn.



Taller sweet gum stems can escape repeated burns and still remain as a dilemma for restoring Long leaf pine flatwoods.

PIPA02 09yr01 (June 2016)

Core Long-leaf Pine area - Plot PIPA05



PIPA 05 - June, 2006



PIPA 05 – June, 2016. Note the Longleaf pine sapling in the foreground.

The Boardwalk fire was a lightning strike in a snag in the floodplain near the newly rebuilt boardwalk. Some damage occurred to the boardwalk due to fire spread but mostly to tree fall. Size was < 0.1 acres.

Boardwalk WF 7_16_2016
33.82611 - 80.81833

Congaree Swamp

Maintenance Road

Service Road

Caroline Slins

Boardwalk_WF

developed_trails

roads

allbuildings

Harry_Hampton_RCW_2012

2014 Rx Burn

Harry_Hampton_RCW_2016_Perimeter

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero
 mapping, Aergrid, IGN, IGP, swis
 sTopographic Society, FCB, Esri, HERE
 and the GIS user community

0.05 0.1 0.2 Miles



Damage to recently rehabilitated boardwalk

Harry Hampton Mastication Project

Mechanical treatment of the Harry Hampton burn unit began early summer 2016 following a 7th prescribed burn treatment on 4/20/16. This was a PMIS funded project (NPS – PMIS Project #194397) focused on reducing basal area within a portion of the Harry Hampton burn unit comprised of dense, off-site stands of loblolly pine in what was formerly a more open longleaf pine wet savanna community containing a robust herbaceous layer. Reduction of basal area was accomplished by mechanically thinning shrubs and pole-sized trees utilizing a Fecon tracked mulching tractor. Prior to implementation of this project during the summer of 2015, vegetation monitoring plots were installed and pre-treatment data were collected including basal area and vegetation species composition. During the initial start-up of the project, the GRSM Fire Effects Team worked as field liaisons/resource advisors for the park providing orientation to the project area, collecting initial photo documentation, and providing basic assistance to operations and safety. **Photo 1** and **2** respectively show an untreated area and an adjacent treated area. Additionally, **Figure 1** illustrates the project area with the monitoring plot locations and delineates the initial area of work.



Photo 1 (Left) and Photo 2 (Right) respectively show an untreated area and an adjacent treated area.

Approximately 70-75 total acres were treated throughout the summer spanning 5 total weeks of work, including some routine maintenance and upkeep of equipment. The actual mechanical treatment within the project area ranges from the northern extent of the unit down to the southeast corner between the visitor center parking and the maintenance area. Monitoring plots will be resampled during the 2017-2018 summer field seasons to determine actual treatment effectiveness, however initial observations indicate significant reduction in basal area within the shrub and pole-sized tree strata. Additionally, light to moderate tilling of the top 1-4 in of soil was common with occasional soil compaction in wetter areas, and mulch production generally appeared to be broadly scattered and light (see **Photos 3 and 4**).

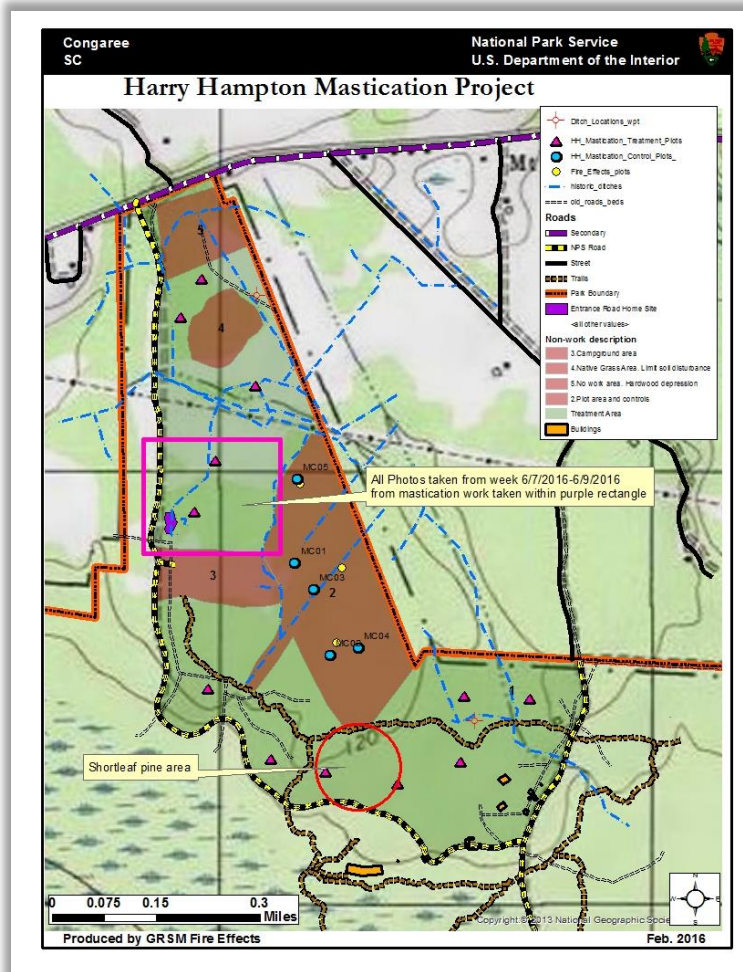


Figure 1. Map of the Harry Hampton project area. Treatment areas are denoted in green and control areas are brick red. Additionally, triangles and blue circles indicate treatment monitoring plots and control monitoring plots respectively. The pink outlined box shows the initial area of work where photo documentation was recorded.



Photo 3 (Left) and 4 (Right) show general tilling effects to soil and overall light mulch production.

Long Term Monitoring Results

There has been no update to the long-term monitoring results table for Congaree. The most recent table of results is included below for the reader's reference (**Table 1**). An update to this table should be completed for next year's annual report.

Table 1. Objectives and long-term monitoring results for CONG

Vegetation Type	Management Objective Restoration Phase- After ?? burns	Monitoring Results (80% confidence intervals)	Objective Achieved?	Year Last Analysis Completed
Longleaf/ Loblolly Pine Woodland (FPIPA1) <i>5 plots</i>	>50% Reduction in total fuel loading	Fuel reduction after 6 burns: 18% (<i>n=4 plots, 1 burn unit</i>)	No	2008
	15-30% Reduction in overstory tree density	Overstory reduction after 5 burns: 4% (<i>n=4 plots, 1 burn unit</i>)	No	2008
	>200 tall (>1m) Longleaf pine seedlings /ac	Preburn density: data not clean After 5 burns: 0 (<i>n=4 plots, 1 burn unit</i>)	No*	2008
Loblolly Pine Forest (FPITA1) <i>5 plots</i>	>50% Reduction in total fuel loading	Total fuel reduction = 38% Preburn avg.: 33.0 tons/acre After 3 burns: 20.6 tons/acre (<i>n=3 plots, 1 burn unit</i>)	No	2008
	>70% Reduction in pole-sized tree density	Pole reduction: After 1 burn: 38% After 2 burns: 46% After 3 burns: 65% (<i>n=3 plots, 1 burn unit</i>)	No	2008
	25-50% Reduction in overstory tree density	Overstory reduction: After 1 burn: 3% After 2 burns: 3% After 3 burns: 8% (<i>n=3 plots, 1 burn unit</i>)	No	2008

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

Cumberland Gap National Historic Park (CUGA): 2016 Fire Effects Monitoring Annual Report

Much of the work of the Appalachian-Piedmont fire effects monitoring crew at CUGA focused on the prescribed burn, post burn monitoring, and long-term monitoring of vegetation and fuels in the Dark Ridge C burn unit. The Dark Ridge C/Sugar Run prescribed burn took place on March 21-23, 2016. Overall, this was a highly effective and interesting burn, and subsequent monitoring uncovered some interesting patterns of fire-adapted vegetation and fire effects within the unit. A short description of the burn and monitoring is provided in the following report.



A line of low-intensity backing fire moves through a significant stand of shortleaf-pine and oak in the low ridges of Dark Ridge C.

Dark Ridge C / Sugar Run B Rx

For 2016, the Dark Ridge C prescribed burn unit was combined with the adjacent Sugar Run B unit, a thin horseshoe shaped strip located along the southeast boundary of Dark Ridge C, thereby increasing total acreage to approximately 500 ac. This marks the third prescribed burn treatment for both units and the most effective for Dark Ridge C, which has previously burned in a patchy manner with overall very low severity. As seen in the USGS extended burn severity imagery (**Figure 1**), overall severity was low, however, burn coverage was very continuous across the unit and the woody understory layer (low shrubs and tree seedlings) was generally top-killed while much of the midstory and overstory remained intact thereby masking the actually understory effects. This is an ideal result and is certainly in line with the short-term and long-term objectives for fire-maintained forests at Cumberland Gap.

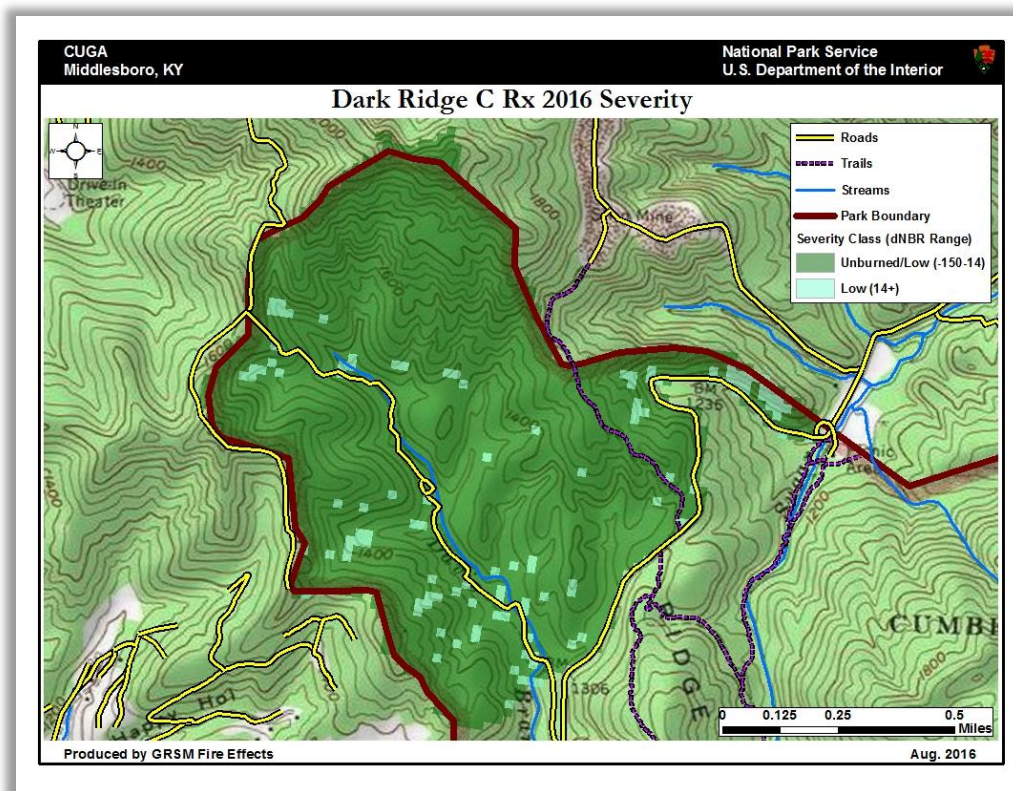


Figure 1. Dark Ridge C 2016 extended burn severity. Note that low impacts to the overstory resulted in the more significant understory effects being masked.

Much of the unit is dominated by dry-mesic oak overstory (a mix of black oak, scarlet oak, chestnut oak and white oak), with more montane oak (characterized by presence of northern red oak) occurring at the most northerly and highest elevation portion of the unit, and a fairly consistent band of low elevation yellow pine / pine-oak (with significant presence of shortleaf pine) along the drier steep and rocky mid to lower slopes. **Photos 1** and **2** are photo points from this year's LFEM monitoring in yellow pine and pine-oak forest, community types which have

not previously been monitored extensively at CUGA and which are a somewhat rare but important fire adapted community within the currently delineated CUGA prescribed burn program.



Photo 1 (Left) and 2 (Right) show examples of pine-oak and low elevation yellow pine forest respectively within the Dark Ridge C burn unit.

Overall, the Dark Ridge C burn unit received an excellent 3rd entry burn and is well prepared for future burn entries, perhaps employing well planned and targeted higher intensity fire to create more mixed severity in the drier parts of the landscape. Additionally, yellow pine stands within this unit should continue to be tracked with future burns and any additional stands of significance within current or future burn units should be targeted for monitoring.

Long Term Monitoring Results

There has been no update to the standard analysis of long-term monitoring results. Consequently, **Table 1** has not been updated for this report, though we include it below as a reference point for reviewing the progress toward achieving program objectives.

Table 1. 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)	Objective Achieved?	Year Last Analysis Completed
Dry Oak Forest (FQUCO1) 16 plots	>50% Reduction in total fuel loading	Total Fuel Reduction: After 1 burn = 29% (± 3) (n = <u>16</u> plots) After 2 burns = 26% (± 2) (n = <u>11</u> plots)	Not yet, but on course	2013
	>70% Reduction in pole-sized tree density (≤ 15 cm dbh)	Pole Reduction: After 1 burn = 39% (± 5) (n = <u>16</u> plots) After 2 Burns = 67% (± 3) (n = <u>11</u> plots)	Not yet, but close	2013
	15-30% Reduction in overstory tree density (>15cm dbh)	Overstory Tree Reduction: After 1 burn = 5% (± 5) (n = <u>16</u> plots) After 2 Burns = 8% (± 1) (n = <u>11</u> plots)	Not yet, but on course	2013
	>200 tall (>1m) Oak seedlings /acre	Preburn mean: 101/acre (± 12) After 1 burn: 91/acre (± 6) (n=16 plots)	Not yet.	2011
	>30% Cover by native herbs	Mean preburn cover = 2% ($\pm 1\%$) Mean after 1 burn = 4% ($\pm 2\%$) (n=14 plots)	No, but more burns are needed.	2011
	< 20 Invasive exotic plants/acre	Preburn avg: 0/acre Post burn mean: 20/acre (± 14) (n=16 plots)	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): 2016 Fire Effects Monitoring Annual Report

As mentioned in the Introduction to this year's report, 2016 will go down in history as the most consequential fire season in the history of Great Smoky Mountains, most notably because of the fires that occurred on November 28. Though there were multiple ignitions that day, the largest fire, Chimney Tops 2, is believed to have burned over 17,000 acres within a 24-hour period on that day, leading to the loss of 14 lives and many homes. This tragic fire was by far the largest in the history of the park, and will come to redefine the potential for rapid fire spread in the eastern mountains.

The busy fire season of 2016 limited the amount of long-term monitoring, though important projects were completed at Arbutus Ridge, Gladys Branch, and numerous other parks (including Shenandoah NP in the NPS Northeast Region). This year's annual report focuses on simply documenting the prescribed burns and wildfires that occurred in 2016. We anticipate doing a great deal of monitoring of the Chimney Tops 2 and other major wildfires in 2017, after which we will undoubtedly be able to say quite a bit more about the effects of these fires on the vegetation and fuels of the Park.

2016 Prescribed Burning

Southeast Arbutus Rx

The SE Arbutus burn unit (~390 ac) received a 3rd prescribed burn treatment on 3/30/16, nine years following the previous treatment in 2007. This was a very effective 3rd entry, with almost complete coverage of fire across the unit and overall low to moderate severity. **Photos 1** and **2** show typical burn day fire behavior with continuous backing and flanking fire coming down from the ridgelines and exposed slopes.



Photo 1 (Left) and 2 (Right) illustrate average fire behavior for SE Arbutus. Flame lengths of backing and flanking fire were typically 1-2 ft with jackpots of fuel exhibiting flame length from 6-10 ft.

Overall fire effects within the target forest communities showed high consumption of leaf litter and wide spread top-kill of woody resprouts, both tree seedlings and shrubs, which had become well established in the understory during the nine year lapse between burns (**Photo 3** and **4**). Additionally, in some areas encroaching midstory and occasional overstory white pine received significant basal wounding.



Photo 3 (Left) and **4 (Right)** show examples of wide spread top-kill of understory woody stems post burn.

Ultimately, this burn did a great job removing the leaf litter without deep duff consumption, checking the growth of woody resprouts in the understory, and to a limited extent, further thinning the midstory and creating a few small canopy gaps. Future prescribed burn treatments should be considered within the next 3-5 years to build on the current progress and continue to control woody encroachment of fire intolerant species in the understory and hopefully promote conditions for yellow pine and oak reproduction.

Cades Cove Rx

The 2016 Cades Cove prescribed burn accomplishments (**Figure 1**) can be divided into spring and early fall burns. The Sparks burn unit (127 ac) and a small southern portion (the majority of the unit had been mowed) of the East Cemetery Marsh unit (~15-20 ac) were completed on 3/7/16 followed by the Cable Mill unit (90 ac) on 3/8/16.

Overall, these burns effectively removed the cured grass and thatch fuels while top-killing encroaching blackberry throughout most of the fields. **Photos 5** and **6** show typical fire behavior in the Sparks and Cable Mill units respectively.

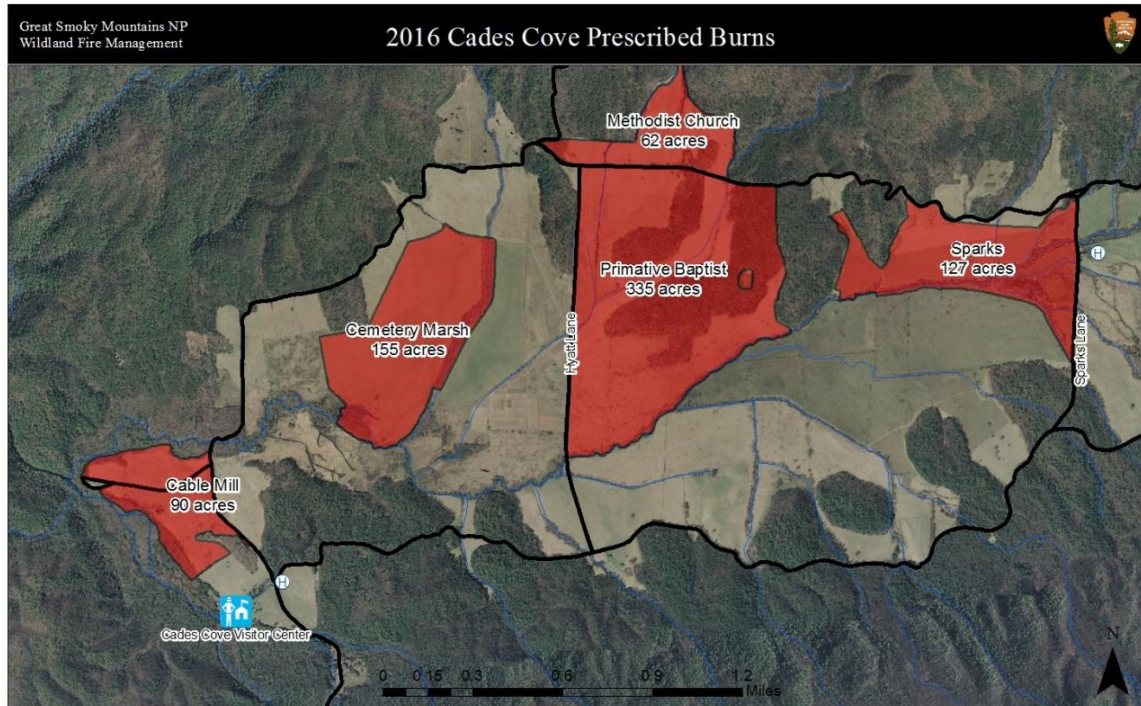


Figure 1. Map of the 2016 Cades Cove grassland prescribed burn units.



Photo 5 (Left) and 6 (Right) show typical fire behavior for Sparks and Cable Mill respectively.

The combined Methodist (62 ac) and Primitive Baptist (335 ac) burn units were completed on 10/4/16, which effectively was still late growing season as summer temperatures persisted late into the year with tree leaves dropping or drying up and browning out due to drought conditions. This is one of, if not the earliest “fall” burns that has been accomplished in Cades Cove. While the fields generally appeared green, live fuel moisture was actually fairly low resulting in a slow,

smoky start (**Photo 7**) but quickly allowing fire to become well established and spread continuously throughout the fields (**Photo 8**).



Photo 7 (Left) shows the initial slow start in green fuels at the north point of the Methodist unit and **Photo 8 (Right)** shows fire pulling together from the well-established east and west flanks of the Methodist unit.

Generally flame lengths were fairly low (<2 ft) during the first part of the day with some higher intensity fire observed in the afternoon (8-10 ft), though accurate measurement were often impeded by thick smoke. Fire under-burned most of the standing vegetation in a fairly continuous manner, effectively removing the thatch while leaving significant standing structure (**Photo 9** and **10**).



Photos 9 (Left) and **10 (Right)** show post burn examples of remaining standing vegetative structure in the Methodist and Primitive Baptist units respectively.

This appeared to be an effective field burn although it is likely the drought played a significant role in availability of live fuels. While much of the encroaching woody vegetation was likely top-killed, it will be interesting to track the longer term effects on woody regrowth next spring/summer to see if there is a reduction in ability to resprout given the timing of the burn. One caveat is that significant invertebrate activity was observed during the burn potentially warranting further investigation into effects of late growing season burns on invertebrates especially since some concerns have already been expressed by butterfly researchers.

2016 Wildfire Highlights

Glady Branch WF



Photo 11. Example of typical fire behavior along the southeast spur of the Glady Branch WF

The Glady Branch wildfire (230 ac) occurred on 4/20/16 during the early growing season. This was a human caused fire on the north shore of Fontana Lake, located on the southern edge of the park. Fire behavior was fairly active (1-3 ft flame length and ~2-4+ cph ROS) given the dry exposed oak litter and breezy conditions (**Photo 11**). This area is somewhat unique compared to much of the park's interior fire-adapted communities because it contains significant occurrence of shortleaf pine and low elevation dry oak species including southern red oak and occasional post oak. Fire coverage was very continuous across the containment area, generally consuming the leaf litter, lightly charring the duff and partially to completely consuming 1000-hr fuels and snags (most yellow pine and oak). Severity was generally low with much of the overstory remaining intact, however there was significant top-kill in the understory and midstory across at least a 1/3 of the unit and the fire burn intensely through a couple recently created (1-2 years old) shortleaf pine snag patches caused by southern pine beetle outbreaks (**Figure 2**).

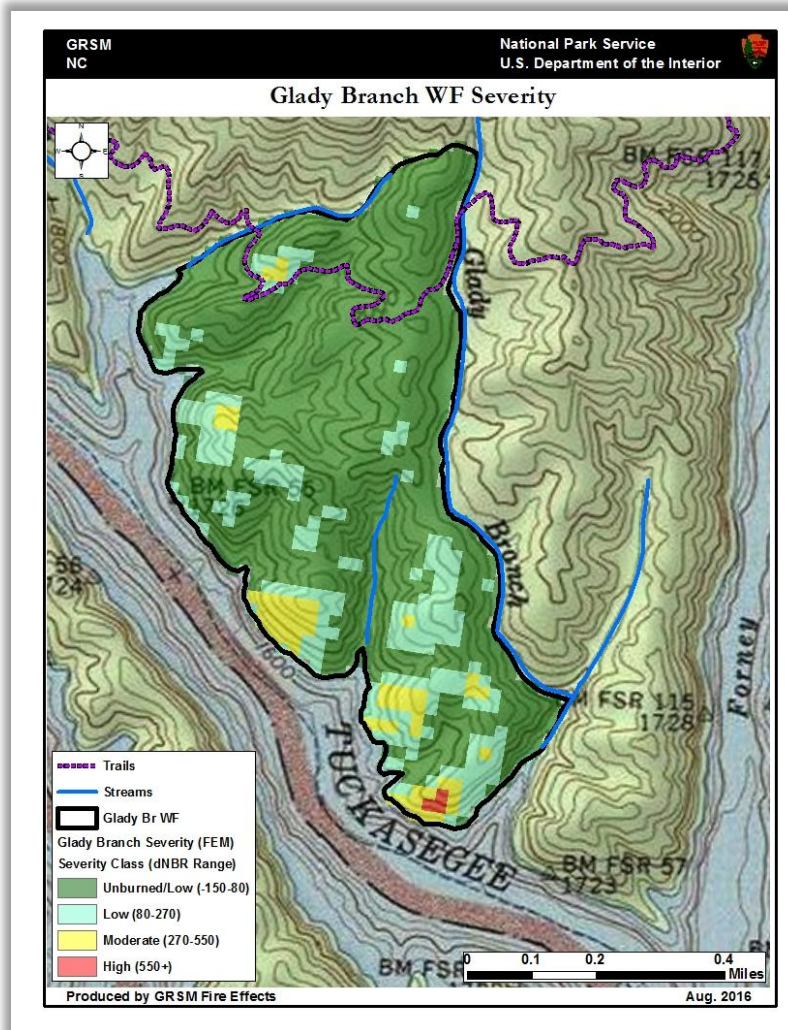


Figure 2. Map of Glady Branch WF burn severity. Much of the impacts were to the understory and occasionally the midstory leaving the overstory largely intact thereby masking the effects (the green unburned/low area). The moderate (yellow) and high (red) severity generally occurred in yellow pine stands, particularly areas with pre-burn overstory mortality from southern pine beetle.

Some limited summer field monitoring was completed within the burn this year collecting CBI data along with associated vegetation species composition. Given the unique forest community type, this will continue to be an area of interest for long term vegetation monitoring, especially with regard to shortleaf pine and oak regeneration.

Crawfish Branch WF

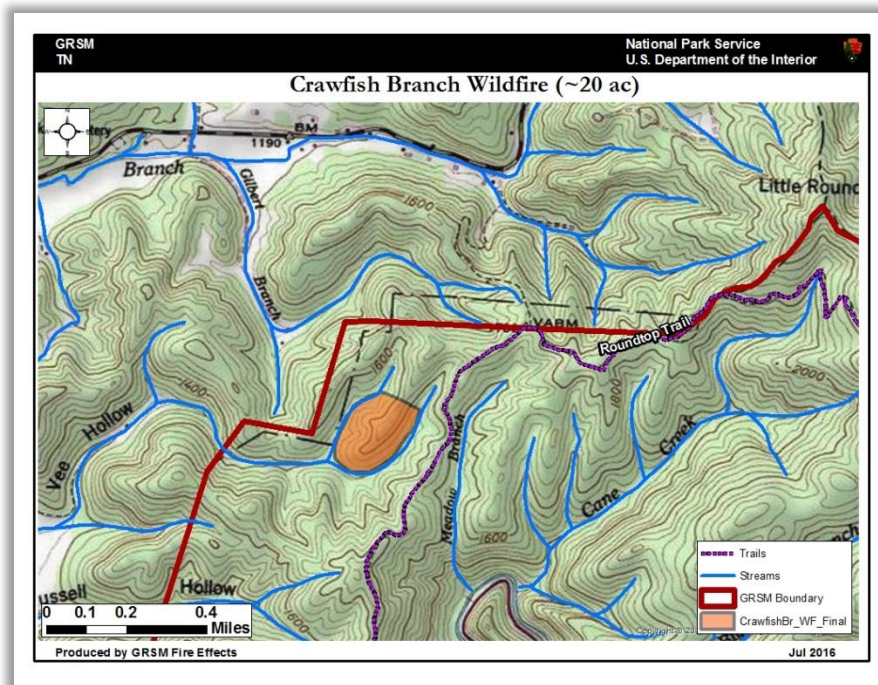


Figure 3. Map showing location of Crawfish Branch wildfire.

Crawfish Branch was a 20 ac lightning caused fire discovered on 6/30/16 off the Roundtop Trail near the north-central boundary of the park between Wears Valley and Townsend (**Figure 3**). This fire marked the first in a string of wildfires that were more resistant to control due to increasing drought conditions resulting in dry receptive duff, 1000-hr fuels, and snags allowing the fire to smolder, retain heat, and burn through typical handlines thereby requiring most containment lines to be dug to mineral soil (**Photo 12**). Once a yellow pine dominated forest, successive waves of southern pine beetle have removed most of the overstory yellow pine from this site leaving a young forest of dry oak, successional mixed hardwoods, and white pine with a moderate to high density mountain laurel shrub layer. Fire behavior was 1-2 ft flame length and 1-2 cph ROS with complete removal of leaf litter, deep smoldering in the duff, and high consumption of heavies (**Photos 13** and **14**). The ridgeline and upper to mid slopes saw almost complete duff consumption with high scorch on the shrub layer and overstory (**Photo 15**), grading into milder effects on the lower slopes where fire generally went out just before reaching the drainages bounding the fire to the east, west and south.



Photo 12 (Left) shows handline construction down to mineral soil, atypical of most wildfires in the Great Smoky Mountains, and **Photo 13 (Right)** shows typical fire behavior on the upper slopes of the burn



Photo 14 (Left) shows heavy smoldering in duff and **Photo 15 (Right)** shows an area along the ridgeline of almost complete canopy scorch, understory to overstory.

Big Shoe WF

The Big Shoe WF was a small (1/4 ac) human caused fire that started on 7/21/16 along the Abrams Creek Trail near Cades Cove (**Figure 4**). Although a very small fire it again proved to be difficult to control due to continued drought conditions, deep smoldering in the duff, and steep rocky soil conditions which made digging very challenging. Ultimately multiple bladder bags of water were hauled up the steep slope from Abrams Creek to extinguish the heat in the rockier parts of the fire where digging was ineffective. **Photos 16** and **17** give a general prospective of site conditions and fire effects.

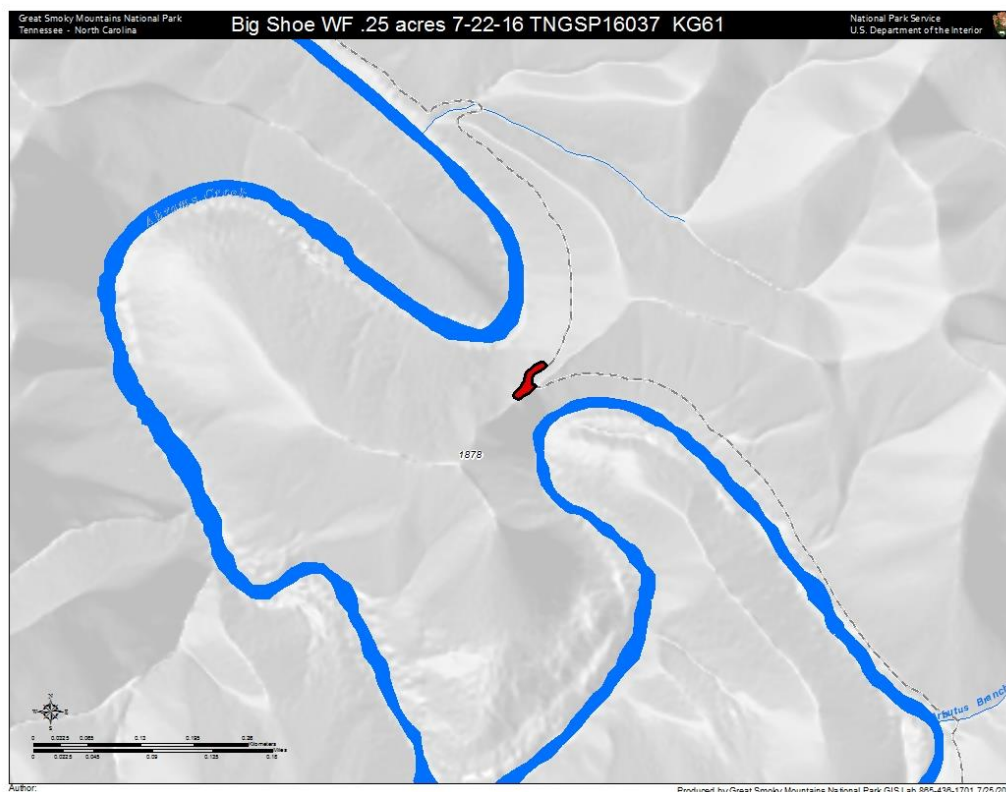


Figure 4. Map showing the location of the ¼ acre Big Shoe wildfire.



Photo 16 (Left) and 17 (Right) respectively give a general impression of fire effects and the steep rocky conditions making control difficult.

Happy Valley Ridge WF

The Happy Valley Ridge wildfire was located on the Tennessee side of the park near the northwestern section of the park boundary at the northeast edge of the Happy Valley community, just south of the Lock Rock Tower area of the Foothills Parkway. The forest communities in this area share some compositional similarities to the Gladys Branch WF, particularly the presence of shortleaf pine and low elevation dry oak species all of which are common in the Tennessee Ridge and Valley geographic province to the north and west of the park but quickly become infrequent on the interior of the park. Although the fire was determined to be lightning caused,

the close proximity to the park boundary and private residences meant suppression was the only management option available. Initial direct attack on 9/15/16 was unsuccessful given the extended drought conditions, requiring a shift to an indirect confine-contain strategy. Resources constructed handlines on 9/16/16 along the southwestern and the northeastern flanks of the fire, connecting Bell Branch to the Cooper Road Trail, creating a 264 acre containment area. Fire behavior was very active on the drier ridgetop and southern slopes with yellow pine and oak fuels. Generally backing and flanking surface fire burned with 2-4 ft flame lengths and 2-5+ cph ROS while readily available jackpots, 1000-hr fuels, and snags exhibit flame lengths 6-8+ ft (**Photos 18** and **19**). Deep smoldering and burning of duff continued to be common across much of the burn requiring most handlines to be dug to mineral soil (**Photos 20** and **21**).



Photo 18 (Left) shows an example of fire behavior in surface litter and **Photo 19 (Right)** shows fire burn down a steep slope in snags, heavies, and evergreen shrubs.



Photo 20 (Left) shows smoldering duff along the north handline and **Photo 21 (Right)** shows widespread smoldering duff around shortleaf pine.

Rain on 9/18/16 significantly slowed the fire's growth for a couple days, but continued smoldering in the duff and heavies allowed fire to rekindle and slowly continue to spread on some of the south facing slopes. The fire was estimated at 125 acres by 9/23/16 and while some growth was still occurring within the containment area to the south above Cooper Road Trail, fire progress to the north, east, and west had effectively been checked by handlines and moister fuels along the more sheltered slopes and drainages (**Figure 5**).

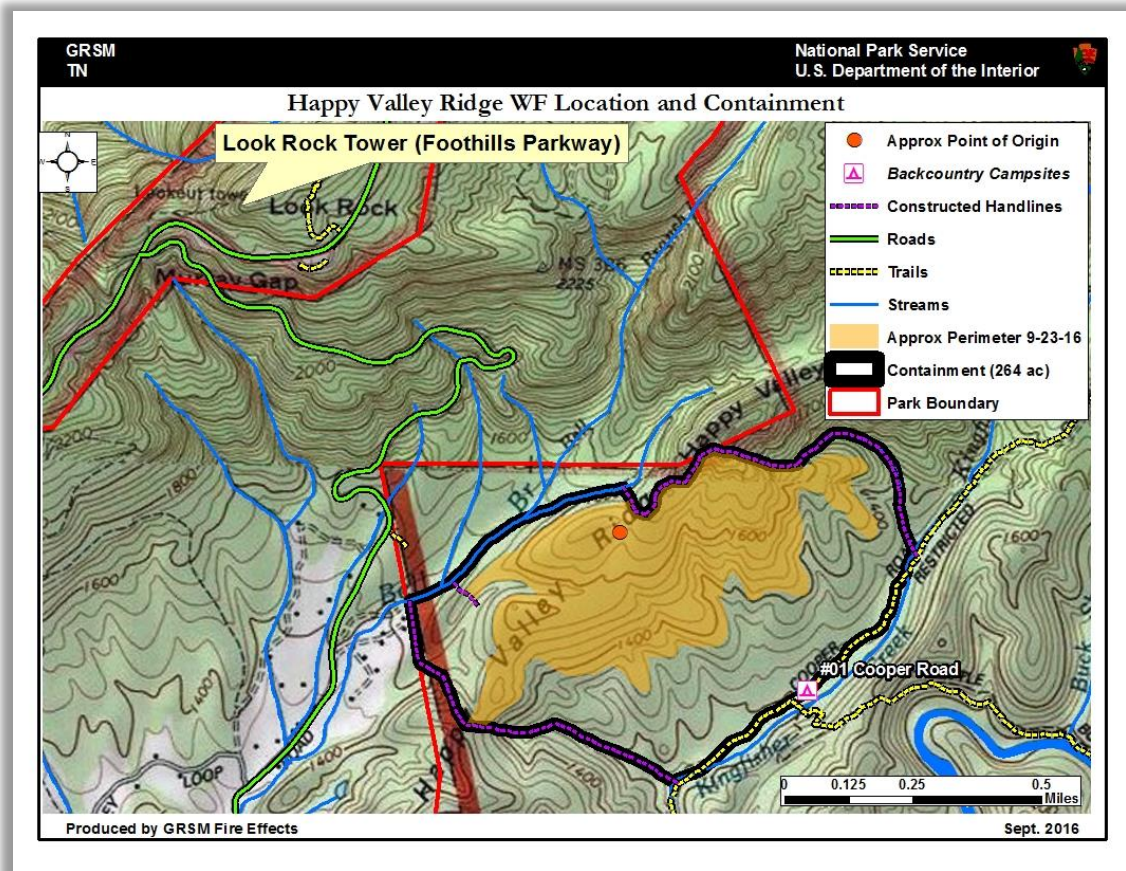


Figure 5. Map showing location of the Happy Valley Ridge WF, the containment area, and the estimated perimeter as of 9/23/16.

Given increasing wildfire workload elsewhere and the possibility of re-burn with ever increasing leaf fall on the burned area from the scorched canopy, the last area of growth on the southwest corner of the fire was finally actively checked with handline on 10/10/16. No further activity or growth was observed after this point. However, notably when the GRSM fire effects team mapped the final fire perimeter on 11/2/16 a short section of smoldering log was found along the southeast edge of the fire which had been slowly burning for some extended period of time as evidenced by the long line of white ash that, at one end, was weathered and partially covered by fallen scorched leaves, grading into uncovered ash that had been weathered by rain, then ash that had not received rain, and finally the freshly fallen ash adjacent to the soldering end of the log (Photo 22).



Photo 22 shows a view looking down along the line of ash toward the burning log found on 11/2/16, roughly 1 ½ months and at least 2 slight rain events after the start of the fire. Notice the progression from weathered, litter covered ash in the foreground to fresh white ash next to the smoldering log in the background.

Fire behavior observations, post-burn reconnaissance, and USGS initial burn severity mapping (**Figure 6**) currently indicate overall low burn severity. However, the widespread amount of deep duff removal will likely result in some degree of overstory decline and mortality within the next growing season, the extent of which is currently unclear. Hence, extended burn severity mapping could show more areas of moderate and possibly high severity.

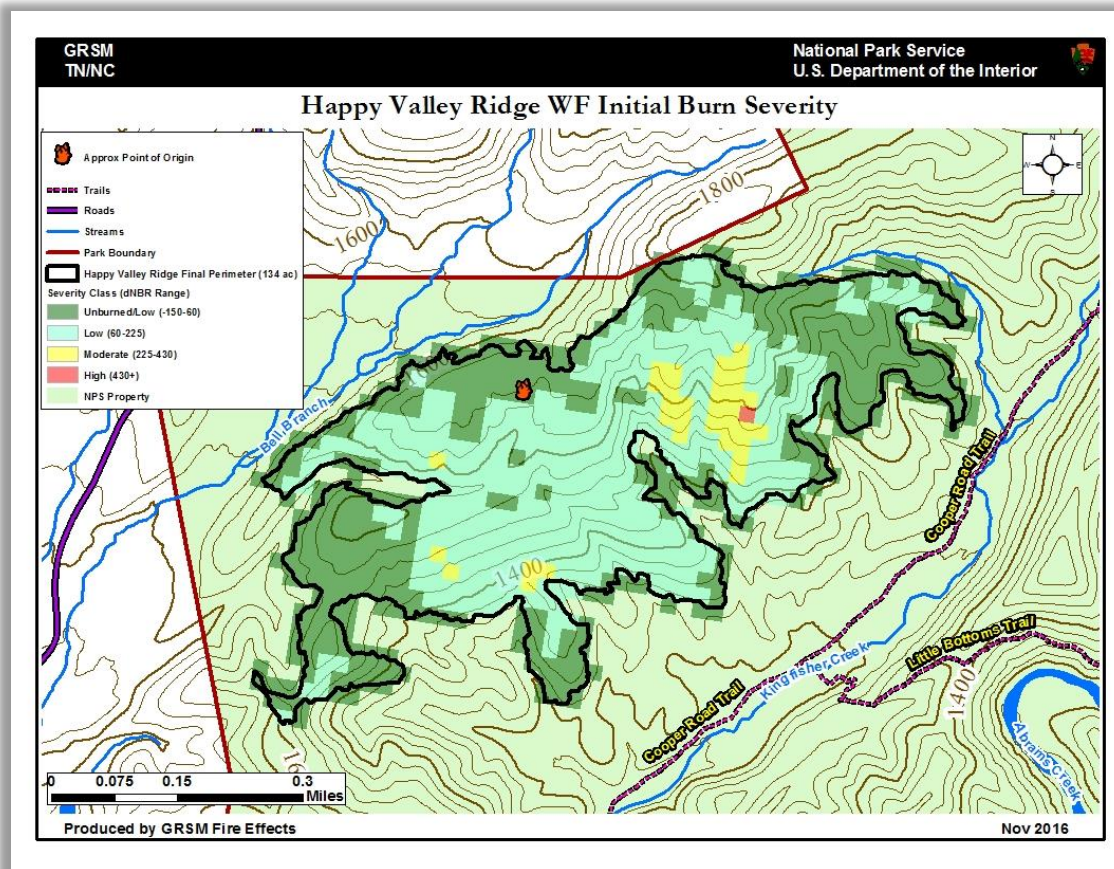


Figure 6. Map of the initial (immediate post-burn evaluation) USGS burn severity classified imagery within the actual final perimeter.

The GRSM fire effects team plans to conduct CBI and vegetation species composition monitoring of this unit during the summer of 2017 and beyond, with a particular focus on the initial and long term effects on the shortleaf pine communities (**Photo 23**). Additionally, given the proximity of non-native invasive weeds just outside the park, BAR funding was applied for by the park's vegetation management crew to help monitor and control exotic plants that may seed into the burned area over the next few summer seasons.



Photo 23 illustrates deep burning of duff around the base of a shortleaf pine tree creating potential for decline or long term mortality.

Chimney Tops 1 WF

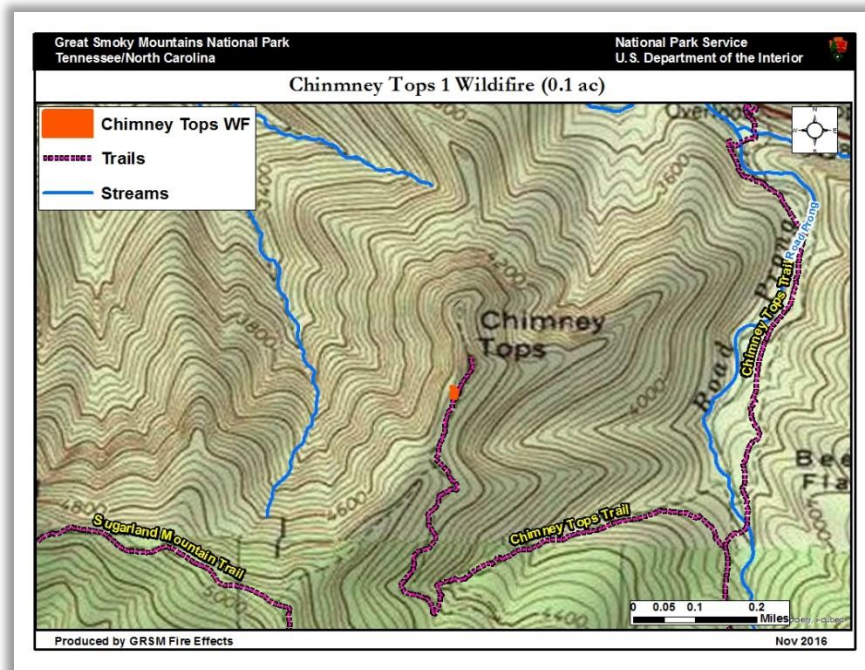


Figure 7. Map of the Chimney Tops 1 WF location.

The Chimney Tops 1 WF was located at the end of and directly adjacent to the Chimney Tops trail, just before the ascent up the first chimney (**Figure 7**). The Chimney Tops Trail is one of the most popular hikes in the Smokies offering panoramic views of the surrounding mountains from the top of 2 prominent rock spires. The trailhead starts along US Hwy 441 located near the heart of the park just south of Gatlinburg. Beginning at ~3440 ft elevation the trail ascends through acid cove (hemlock dominated) and northern hardwood forest to the lower edge of spruce forest (none of which are typically considered fire adapted communities) over a 2 mile distance ending at the base of the first and tallest spire or chimney which reaches 4725 ft in elevation. Initial attack on the Chimney Tops 1 wildfire began on 11/13/16 with a squad of firefighters anchoring off the trail and putting direct line around the 0.1 acre burn during the first operational period. At this point in time numerous active wildfires were burning outside the park both in NC on USFS and BIA lands and in TN on state and private lands. Drought conditions were becoming extreme with KBDI reaching 555 on the TN side of the park and 425 on the NC side. Drift smoke was almost constantly in the air resulting in very poor air quality (**Photo 24**).

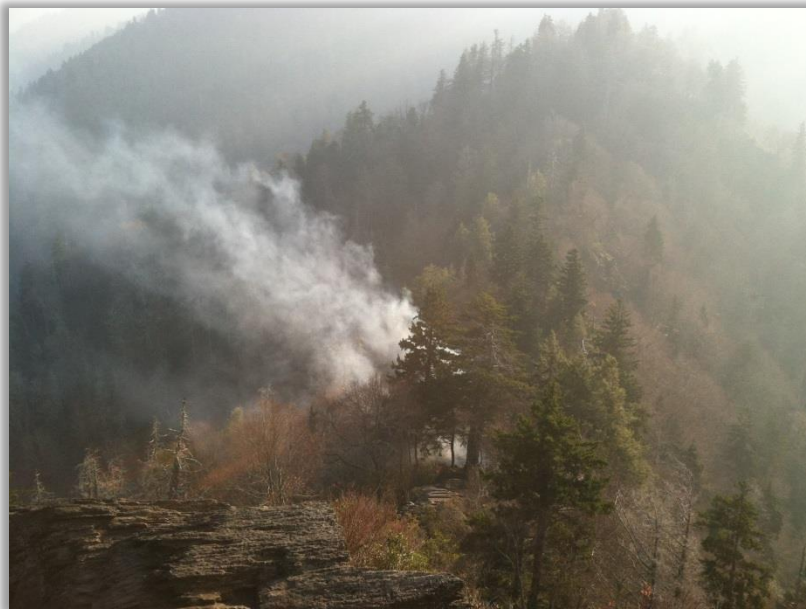


Photo 24 Shows a view of the Chimney Tops 1 WF in the saddle below Chimney Tops proper, taken from the top of the first chimney. Notice how smoky the air is from wildfires burning outside the park in both Tennessee and North Carolina.

The fire was assumed to be human caused, possibly a warming fire, but no definitive point of origin was identified. Typically fires in this fuel type are rare and when they occur have almost no spread potential because the litter is compact and moist and the duff, heavies, and evergreen shrubs are not very receptive. However, given the exceptionally dry conditions and the topographic exposure of the site, fire was almost completely consuming heavies and the often deep peat-like duff layer including the roots of living shrubs and small trees originating in the duff (**Photo 25**). This coupled with the steepness of the slope the fire was burning on and the loose shaley rock underlining the duff made holding the fire within the containment lines difficult especially since water was not readily available to extinguish the duff and heavies or cool the hot rocks. Hence it required firefighters to meticulously excavate the smoldering duff down to the underlying rock, being careful not to dislodge hot rocks that could roll outside the

burn, and to haul bladder bags multiple times back and forth up the trail from distant water sources for 3 additional days before the fire could finally be considered contained.



Photo 25 was taken on the first day looking north toward the base of the first chimney (not visible) along the top of the fire with the trail located to the right and the bottom of the fire down the steep rocky slope to the left. The smoldering fire behavior is slowly but completely consuming the duff, heavies, and small shrubs and trees, leaving only loose bare rock.

It seems likely that had the fire been much bigger during initial attack, ground resources would not have been able to safely or effectively engage and contain the fire due to the increasing steepness of slope and presence of rock outcrops and overhangs around and below the fire.

East Millers Cove

The East Millers Cove wildfire was a human caused start on the afternoon of 11/17/16 on the steep, rocky south face of Chilhowee Mountain just above Walland Elementary School located north of the East Millers Cove community and east of US Hwy 321 and the Little River (**Photo 26**). While not on park service land it was located north of the park and within 1 mile of the Foothills Parkway, a narrow strip of scenic parkway managed by the park and located along the north side of the park. Given the extreme drought conditions, topographic orientation, and highly receptive yellow pine and oak fuels, the fire exhibited rapid growth within the first operational period, threatening numerous structures in the Walland area, particularly East Millers Cove.



Photo 26 is an aerial view of the East Millers Cove wildfire taken on the afternoon of the initial start.

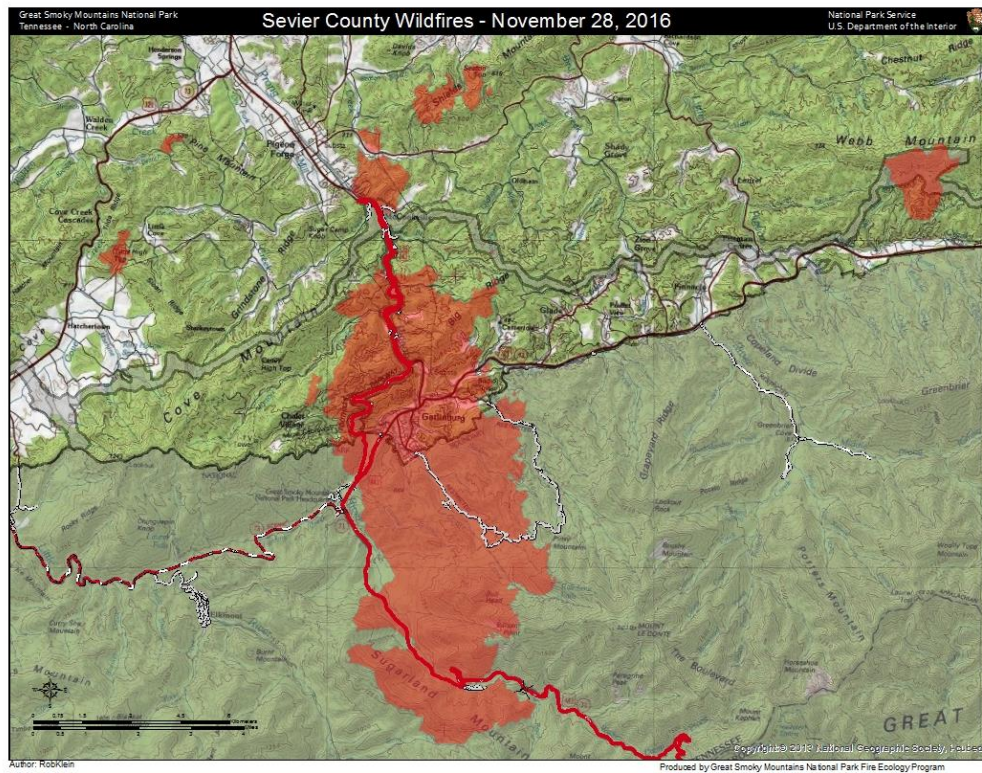
Park service fire staff assisted with initial and extended attack on the fire, with the bulk of heavy line construction completed by Tennessee Department of Forestry dozers along with vital suppression efforts from a variety of aerial resources. Ultimately, the fire grew to a final acreage of ~1500 ac within a couple weeks of initial attack, burning a significant fire adapted landscape in the Tennessee Ridge and Valley geographic province along the north side of the park.

Chimney Tops 2

As mentioned in the Introduction to this year's report, there hasn't been adequate time to assess or document the Chimney Tops 2 wildfire, which was the largest fire in the Park's history, and one of the most destructive wildfires in the nation's history. As of this writing, the official Incident Review is ongoing, and recovery efforts in the park and surrounding communities are in progress. For this year's report, we've included some basic information about the ecology and preliminary effects of the fire, along with a few maps. Much of this information was produced by the BAER team that responded to the fire on December 4-18, 2016.

- **Total Size: 17,140 acres**
- **Total NPS acres: 10,964 acres**
- **All but approximately 50 acres burned on November 28, 2016**

Map 1. Sevier County Wildfires of November 28, 2016. Chimney Tops 2 is the largest fire.



Map 2. Burned Area Reflectance Classification Map – Initial Vegetation Severity with Thresholds Informed by 120 Ground-Validation Points

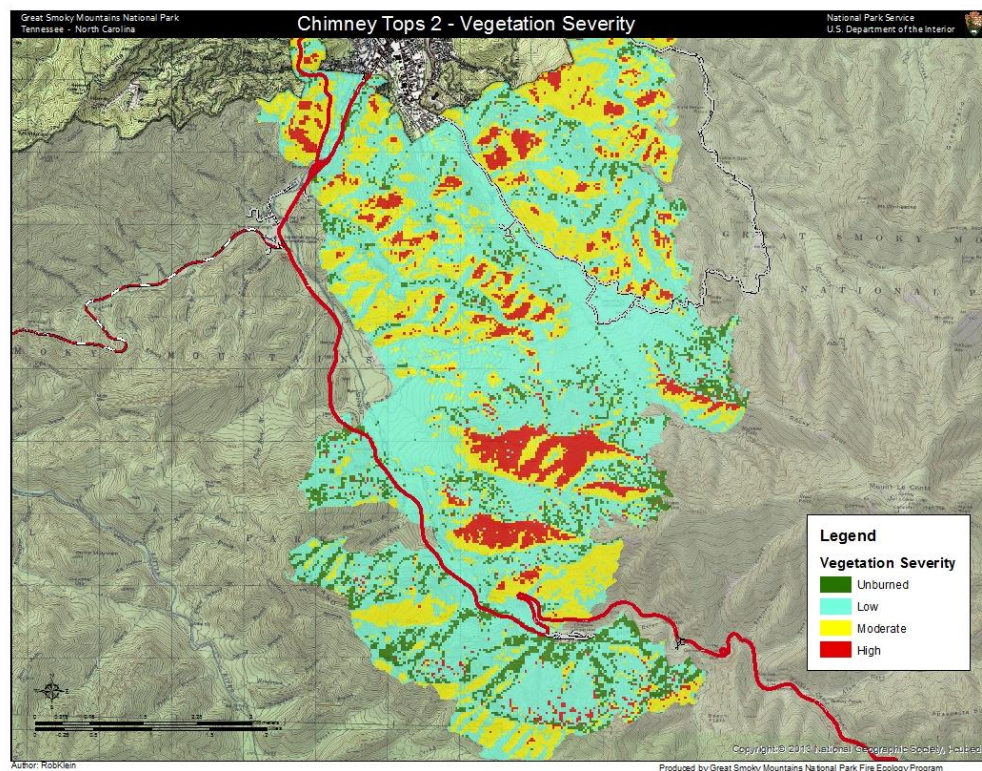


Table. Major Vegetation Types and Severity Class Breakdown for Each (Initial BARC)

Vegetation Type	Percent of NPS Acres	Percent Unburned/Low Severity	Percent Moderate Severity	Percent High Severity
Chestnut Oak (Dry Oak)	24% 2614 ac	45% 1164 ac	43% 1130 ac	12% 320 ac
Northern Hardwoods	16% 1772 ac	81% 1427 ac	15% 263 ac	5% 82 ac
Oak-Hickory	16% 1791 ac	68% 1216 ac	29% 519 ac	3% 56 ac
Cove Forest	15% 1636 ac	82% 1348 ac	16% 268 ac	1% 20 ac
Yellow Pine	9% 952 ac	27% 254 ac	38% 359 ac	36% 339 ac
Successional Hardwoods	9% 940 ac	91% 851 ac	9% 82 ac	< 1% 7 ac
Floodplain Forest	3% 332 ac	81% 269 ac	18% 59 ac	1% 4 ac
Heath Bald/Shrub	1% 124 ac	60% 74 ac	15% 18 ac	26% 32 ac
Spruce-Fir	< 1% 30 ac	80% 24 ac	17% 5 ac	3% 2 ac

Cobbly Knob Fire

The Cobbly Knob fire started on November 28, 2016 – as a result of the same extreme wind event that led to the rapid growth of the Chimney Tops 2 fire. The Cobbly Knob fire resulted from a damaged power line, and burned 446 acres of NPS land – 764 acres overall. Nearly 100 homes were destroyed in the Cobbly Knob community. The NPS land that was affected by this fire is part of the Foothills Parkway right-of-way (unfinished section), and is separate from the main park. Accessibility is very limited, and not as much information exists about the pre-fire resource. In general, vegetation is comparable for the same elevation range within the Chimney Tops 2 fire, with Pine-oak-heath vegetation on ridges and upper exposed slopes, oak and oak-hickory forest on lower exposed slopes and upper protected slopes, and mixed mesophytic hardwoods on the most protected sites. Burned Area Reflectance Classification (BARC) maps were produced for both soil and vegetation severity of the Cobbly Knob fire in conjunction with the Burned Area Emergency Response (BAER) for the Chimney Tops 2 fire. The maps are not included in this report, but the percentages of each severity class are similar to those of the Chimney Tops 2 fire, which are included above. Extended assessment dNBR will be developed for this fire in the coming months, and plot-based severity monitoring is planned for the upcoming 2 years.

Long Term Monitoring Results

No new analysis of long-term monitoring results is available for this report. **Table 2** contains the most up-to-date analysis of long-term monitoring objectives that is available for GRSM.

Table 2. Objectives and long-term monitoring results for GRSM

Monitoring Type	Management Objective Restoration Phase- (After 4 burns)	Monitoring Results (80% confidence intervals)	Objective Achieved?	Year Last Analysis Completed
Yellow Pine Woodland (FPIRI1) 27 plots	>50% Reduction in total fuel loading	Total fuel reduction: After one burn = 36% ($\pm 5\%$) ($n=23$) After two burns = 37% ($\pm 4\%$) ($n=16$)	Not yet, but on course.	2011
	>70% Reduction in pole-sized tree density	Pole reduction: After one burn = 54% (± 5) ($n=25$) After two burns = 75% (± 7) ($n=11$)	Yes	2009
	25-50% Reduction in overstory tree density	Overstory reduction: After one burn = 20% ($\pm 5\%$) ($n=25$) After two burns = 41% (± 9) ($n=11$)	Yes, but more burns are needed before drawing conclusions.	2009
	>200 tall (>1m) Yellow Pine seedlings /ac	Preburn density: 0 ($n=25$) After 1 burn: 97/ac (± 49) ($n=25$) After 2 burns 49/ac (± 40) ($n=11$)	No, but more burns are needed.	2009
	>40% Cover by native herbs/subshrubs	Preburn cover: 3% ($\pm 1\%$) ($n=23$) After 1 burn: 11% ($\pm 4\%$) ($n=23$) After 2 burns 10% ($\pm 6\%$) ($n=9$)	No, but more burns are needed.	2009
Dry Oak Forest (FQUCO1) 15 plots	>50% Reduction in total fuel loading	Total fuel reduction: After one burn = 29% ($\pm 3\%$) ($n=11$)	Not yet, but on course.	2011
	>70% Reduction in pole-sized tree density	Pole reduction: After one burn = 34% ($\pm 7\%$) ($n=11$)	Not yet, but on course.	2011
	15-30% Reduction in overstory tree density	Overstory reduction: After one burn = 5% ($\pm 2\%$) ($n=11$)	Not yet, but good gradual movement.	2011
	>200 tall (>1m) Oak seedlings /ac	Preburn density: 20/acre (± 23) ($n=10$) After 1 burn: 4/ac (± 6) ($n=10$)	No, but more burns are needed.	2011
	>30% Cover by native herbs/subshrubs	Preburn cover: 4% ($\pm 2\%$) ($n=9$) After 1 burn: 4% ($\pm 2\%$) ($n=9$)	No, but more burns are needed.	2011

Kings Mountain National Military Park (KIMO): 2016 Fire Effects Monitoring Annual Report

Saddleback Rx

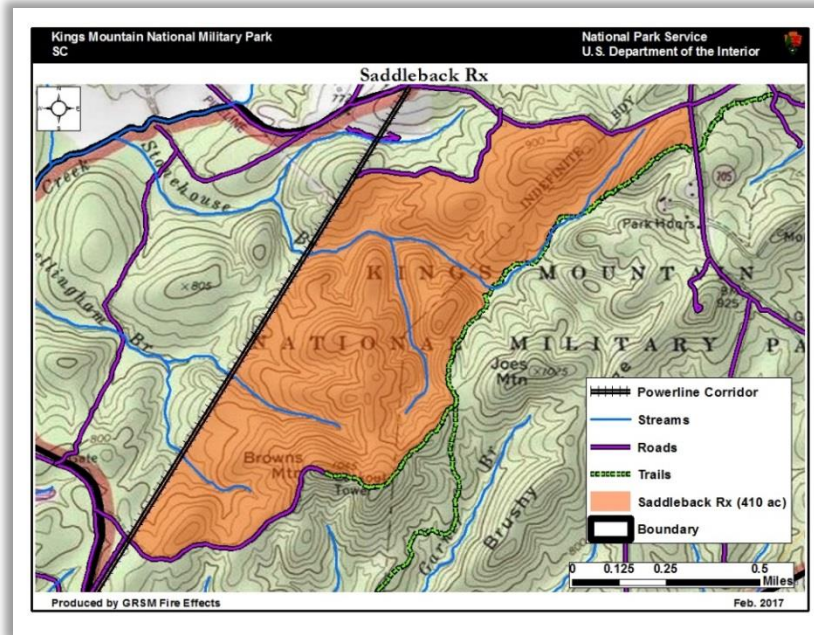


Figure 1. General overview map of the Saddleback prescribed burn unit.

The 4/14/16 prescribed burn treatment of the Saddleback unit (**Figure 1**) marks the 4th burn for this area since 2000 when Brown's Mountain, a smaller sub-unit, was first burned. This was an early growing season burn with overstory trees mostly leafed out and understory trees and shrubs partially leafed out (**Photo 1**).



Photo 1 shows fire backing downslope from the top of Brown's Mountain. Notice tree seedlings and low shrubs are in the early stages of leafing out.

Overall fire intensity was low to moderate with flame lengths generally <3-4 ft, and coverage of fire was continuous across much of the unit, occasionally becoming more patchy on the xeric ridgetops where leaf litter can be wind-swept and scattered. High consumption of leaf litter was common across much of the unit with consistent top-kill of tree seedlings and low shrubs and occasionally larger evergreen shrubs and smaller pole-sized trees on the more xeric ridgetops and upper slopes (**Photos 2** through **5**).



Photo 2 (Left) shows scorched and top-killed tree seedlings and complete litter consumption as fire backs downslope through an oak forest on Brown's Mountain, and **Photo 3 (Right)** shows fire backing through an area of shortleaf pine regeneration.



Photo 4 (Left) and **Photo 5 (Right)** show some of the general fire effects immediately post burn. Top-kill of tree seedlings occurred on slightly more protected slopes with closed canopy chestnut oak forest, while drier ridgetop areas of xeric oak and pine experienced heavy scorch and top-kill of evergreen shrubs, tree seedlings, and small poles

Shortleaf pine regeneration has been one of the most notable longer term effects of previous moderate to high intensity burn treatments as seen in **Photo 3**. This burn limbed and thinned out some of the pine regeneration, but probably did not significantly reduce stem density as shortleaf pine is well adapted to survive moderate to high scorch in addition to being able to readily resprout like a hardwood. Overall, this was the lowest severity burn of this unit especially compared to 2004 and 2011 burns which created and/or expanded multiple large overstory canopy gaps. In contrast, much of the effects of this burn entry were limited to the understory. The GRSM Fire Effects team plans to acquire the full series of USGS burn severity imagery for this and all previous burns of saddleback to use as a monitoring tool and record of treatment progression.

Long Term Monitoring Results

2009 was the last time that long-term monitoring results for KIMO were updated (**Table 1**), but there was not enough data collected during 2015 to improve the current analysis. As noted before, the results indicate that KIMO is on track toward achievement of its management objectives. Despite the large number of plots at KIMO, however, there are significant trends in fire effects that are not being captured in the plot data. These trends are still being explored, and have been discussed in previous reports and presentations.

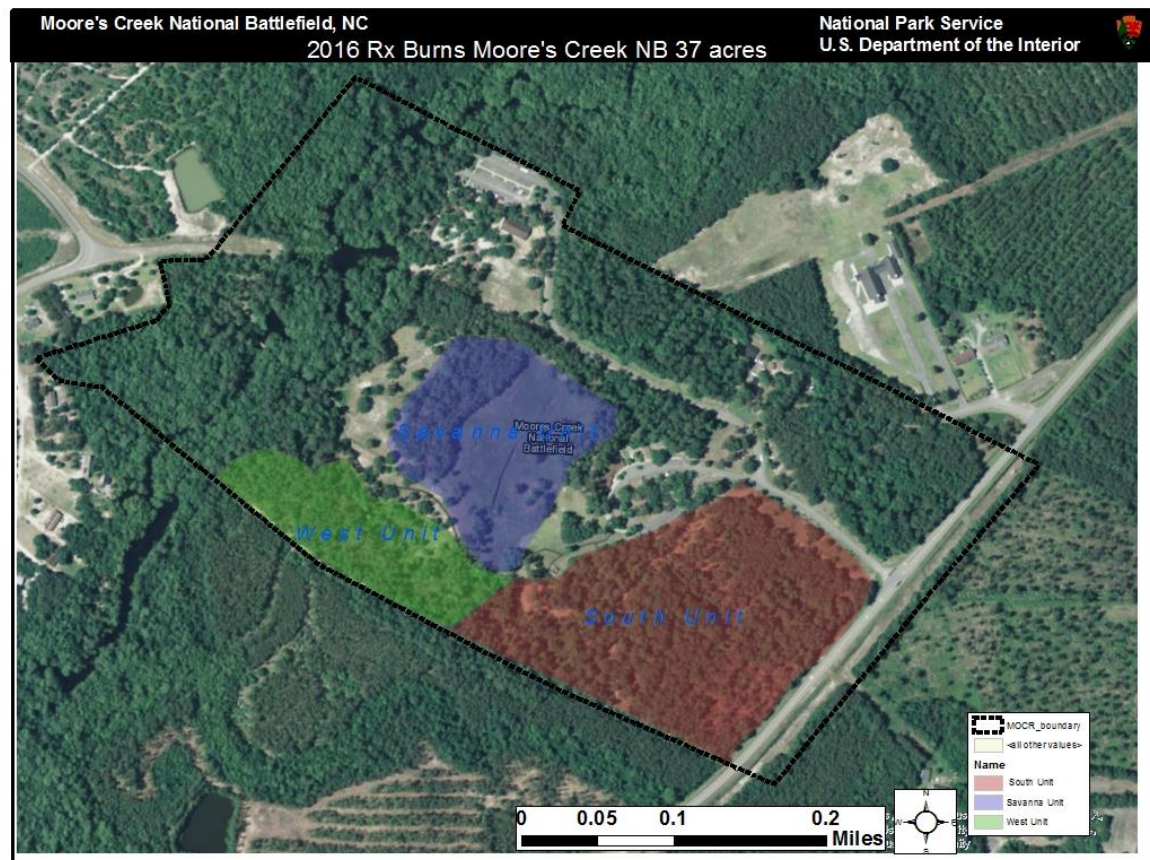
Table 1. Objectives and long-term monitoring results for KIMO

Monitoring Type	Management Objective Restoration Phase- (After 4 burns)	Monitoring Results (80% confidence intervals)	Objective Achieved?	Year Last Analysis Completed
Chestnut Oak-Blackjack Oak Woodland (FQUMA1) <i>8 plots</i>	>50% Reduction in total fuel loading	Total fuel reduction: After one burn = 47% ($\pm 4\%$) ($n=7$)	Not yet, but on course.	2009
	>70% Reduction in pole-sized tree density	Pole reduction: After one burn = 45% ($\pm 12\%$) ($n=8$) After two burns = 62% ($\pm 12\%$) ($n=4$)	Not yet, but on course.	2009
	15-30% Reduction in overstory tree density	Overstory reduction: After one burn = 30% ($\pm 11\%$) ($n=8$)	Yes	2009
	>30% Cover by native herbs	Preburn cover: 6% Cover after 1 burn: 9% ($n=7$)	No, but more burns are needed.	2009
Dry Oak Forest (FQUM01) <i>21 plots</i>	>50% Reduction in total fuel loading	Total fuel reduction: After two burns = 41% ($\pm 5\%$) ($n=19$)	Not yet, but on course.	2009
	>70% Reduction in pole-sized tree density	Pole reduction: After one burn = 43% ($\pm 2\%$) After two burns = 58% ($\pm 5\%$) ($n=19$)	Not yet, but on course.	2009
	15-30% Reduction in overstory tree density	Overstory reduction: After one burn = 7% ($\pm 3\%$) After two burns = 12% ($\pm 3\%$) ($n=19$)	Not yet, but on course.	2009
	>200 tall (>1m) Oak or shortleaf pine seedlings/acre	Preburn density = 85/ac (± 49) After one burn = 55/ac (± 34) After two burns = 55 stems/ac (± 32) ($n=19$)	No, but more burns are needed.	2009
	>15% Cover by native herbs/subshrubs	Preburn cover: <1% After 1 burn: 1% After 2 burns: 1-2% ($n=19$)	No, but more burns are needed.	2009

Moore's Creek National Battlefield (MOCR): 2016 Fire Effects Monitoring Annual Report

Moore's Creek National Battlefield 2016 Fire Summaries

Savannah and the South/West Prescribed fire units were burned on 4/21/2016. Savannah is 12 acres and South/West combined were 25 acres



This operation happened with the help of the North Carolina Nature Conservancy prescribed fire crews. Preparation work was done by the local staff, and Atlantic White Cedar trees were brushed around to reduce mortality and further damage to the remaining trees. The previous trees that were noted in 2014 to have higher than average char heights now were dead.

The fire operations started at 1615 on the South/West Unit and finished up on the Savannah unit. Fire carried extremely well in the South and West units especially where shrub densities were thick. Fire behavior was much more active on this unit than in 2014. Ignitions were complete around 1800 but it is unclear if the unit to the West of West was burned.

Consumption of fine and medium fuels was very good. Significant charring and scorch of pole-sized trees throughout the South/West units was common. Careful ignition in these fuels is needed in the future to not create large openings with hardwood re-sprouts and encourage native forb and grass response while slowly decreasing tree density.



Figure 6 Fire behavior along the South fire road

Upon completion of the South/West Units fire intensity may have been too hot where two ignition lines pulled in (single tree torching was spotted) and may have resulted in above average canopy mortality. No post burn fire effects monitoring was done during the growing season and further monitoring may need to happen. Although these may be the desired effects long term, it is unclear if it helpful in the beginning stages of restoration. Opening the canopy at this time may result in rapid growth of undesirable sweet gum saplings.



Figure 7 Ignition along Hwy 210 where North and South lines pull together

Once firing was complete with South and West, crews moved to Savannah unit. Heavy ignition occurred inside the woodlot and some mortality will likely be seen in the future. Conversely, fire did not carry completely through the Savannah unit and the wettest part of the unit did not burn.



Figure 8 Backing fire in Savannah Unit at approx. 1900

Lastly, the 2 remaining pictures are used to document stand structure in the Atlantic White-cedar/Shining Fetterbush Forest CEG007563.



Photo taken just prior to fire reaching the Atlantic White Cedar area in 2014. This documents pre-Rx fire structure and conditions



Although not the same photos, post burn effects in the Atlantic white cedar area following the 2016 Rx burn

Additional Program Information

Table 1. Planning - 2016

Park	Does Park have written DFCs? (yes or no)	Date Park-level Monitoring Plan completed (or revised)	Total # of Project- or Community- level Monitoring Plans (not just 2016)	Assisted with how many BAER plans in 2016?
BISO	yes	n/a	0	0
BLRI	yes	n/a	0	0
CAHA	no	n/a	0	0
CONG	yes	n/a	0	0
COWP	no	n/a	0	0
CUGA	yes	n/a	0	0
GRSM	yes	n/a	0	2
KIMO	yes	n/a	0	0
MOCR	no	n/a	0	0

Table 2. Monitoring - 2016

Park	% 2016 Data entered	%2016 Data Quality Checked	# of Prescribed Fires Monitored	# Non-Fire Fuels Treatments Monitored	#Wildfires Monitored	#BAER Treatments Monitored
BISO	50	50	1	0	0	0
BLRI	50	50	1	0	2	0
CAHA	n/a	n/a	0	0	1	0
CONG	50	50	1	1	0	0
COWP	n/a	n/a	0	0	0	0
CUGA	50	50	1	0	0	0
GRSM	50	50	5	0	3	0
KIMO	50	50	1	0	0	0
MOCR	n/a	n/a	1	0	0	0

Table 3. Communicating Results - 2016

Park	# of Project Monitoring Reports completed in 2016	# of Annual meeting(s) with Park staff	# of Formal presentations of results	Do you use Minitab?*
BISO	1	1	0	Yes
BLRI	1	0	0	Yes
CAHA	1	1	0	No
CONG	2	1	0	Yes
COWP	0	0	0	No
CUGA	1	1	0	Yes
GRSM	2	1	0	Yes
KIMO	1	1	0	Yes
MOCR	1	1	0	No

Table 4. Research - 2016

Park	Are research needs identified in FMP or Monitoring Plan? (yes or no)	# of Proposals Submitted in 2016	# of Proposals Funded in 2016	# of Research Projects Supported in 2016*	Additional Comments
BISO	yes	0	0	1	
BLRI	yes	0	0	0	
CONG	yes	0	0	1	
COWP	yes	0	0	0	
CUGA	yes	0	0	1	
GRSM	yes	0	0	3	
KIMO	yes	0	0	1	
MOCR	yes	0	0	0	

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

Fire Ecologist and Fire Effects Crew Accomplishments and Areas of Focus

Table 1. Fire Ecologist 2016 Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Detail /Acting Role	2%	Acting-FMO of Appalachian/Piedmont that included implementation of the Phase 2 Medical Standards/FFT Physical process with multiple Risk Mitigation/Waiver cases.
Data Collection	10%	Field work at GRSM, CUGA, and KIMO. FMH plots, LFEM plots, and qualitative surveys.
Planning	25%	Fire effects program planning. AP Zone planning (interpark agreement, park visits, Starfire, FMP support for CHCH, KIMO, CUGA, and CONG), BAER team for Chimney Tops 2 wildfire at GRSM
Data analysis	7%	Estimated amount of time spent performing analyses, including data summaries and statistical tests. Tabular and spatial data.
Data management	5%	Routine data management tasks
Supervision/Admin	10%	Budget/Realignment issues. Hiring, Supervision, Performance evaluations, IDPs, travel, payroll, crew support, purchasing etc.
Fire Operations	15%	Large number of wildfires at GRSM, BLRI. Prescribed burns.
Writing	7%	Work on monitoring plans; Proposal writing. Annual report. Detailed correspondence.
Educational Outreach	5%	Purdue University Ecology field trip, VIP field trip, FLN presenter, Local High School seminar
Partnerships	5%	Continued communications with numerous partners
Research/ Publications	6%	Landscape Conservation Forecasting at GRM, multi-park analysis of tree mortality with USFS Southern Research Station, collaboration with Clemson on multi-park fire effects analysis
Miscellaneous	2%	Mostly communication; E-mails, phone calls, informal planning discussions.
Training	1%	Supervisory and required NPS training; fire refresher

Table 2. Fire Effects Crew 2016 Accomplishments/Focus Areas

Category	Percent Time	Notes
Planning	10%	Planning related to prescribed fire projects including meetings, preparation for burns and communications of objectives
FMH plots	20%	FMH plots at CONG, GRSM, KIMO and BISO
Qualitative Monitoring	5%	Completed Qualitative monitoring at BISO and GRSM
CBI plots/Landscape Fire Effects Monitoring (LFEM)	5%	Long term LFEM plots at BLRI(Air Bellows) and CONG(HH-mastication work) A few LFEM plots installed at CUGA in Dark Ridge C. GRSM LFEM work was done on Gladly Branch WF on Lake Fontana NC
Wildfire assignments	20%	Lead –READ assignment on Pioneer Fire, Boise NF, Idaho; Lead and Crew assisted on multiple wildfires in the Mississippi and Appalachian Zone
Prescribed fire projects	15%	Assisted with implementation and mop-up of burns at BLRI, BISO, CUGA, CONG, GRSM, KIMO, LIRI,
Non-fire fuels projects	< 5%	Re-established CONG 17 mastication plots and observed field operations of equipment.
Travel out-of-park for plot or project work	5%	
Data entry	10%	Approximately 50% entered
Data analysis	<5%	This is expected to be very low number or zero for fire effects crew/lead monitor
Supervision/Admin	5%	Supervision of crew for completing field and office work , as well as time, travel and purchasing paperwork
Training	<5%	LEAD attended training with TNC –Single Resource class in Apopka Florida; Identification of sedges at Highlands Biological institute. Crew attended National Park Service Workplace Harassment Training
Miscellaneous	<1	

The End.